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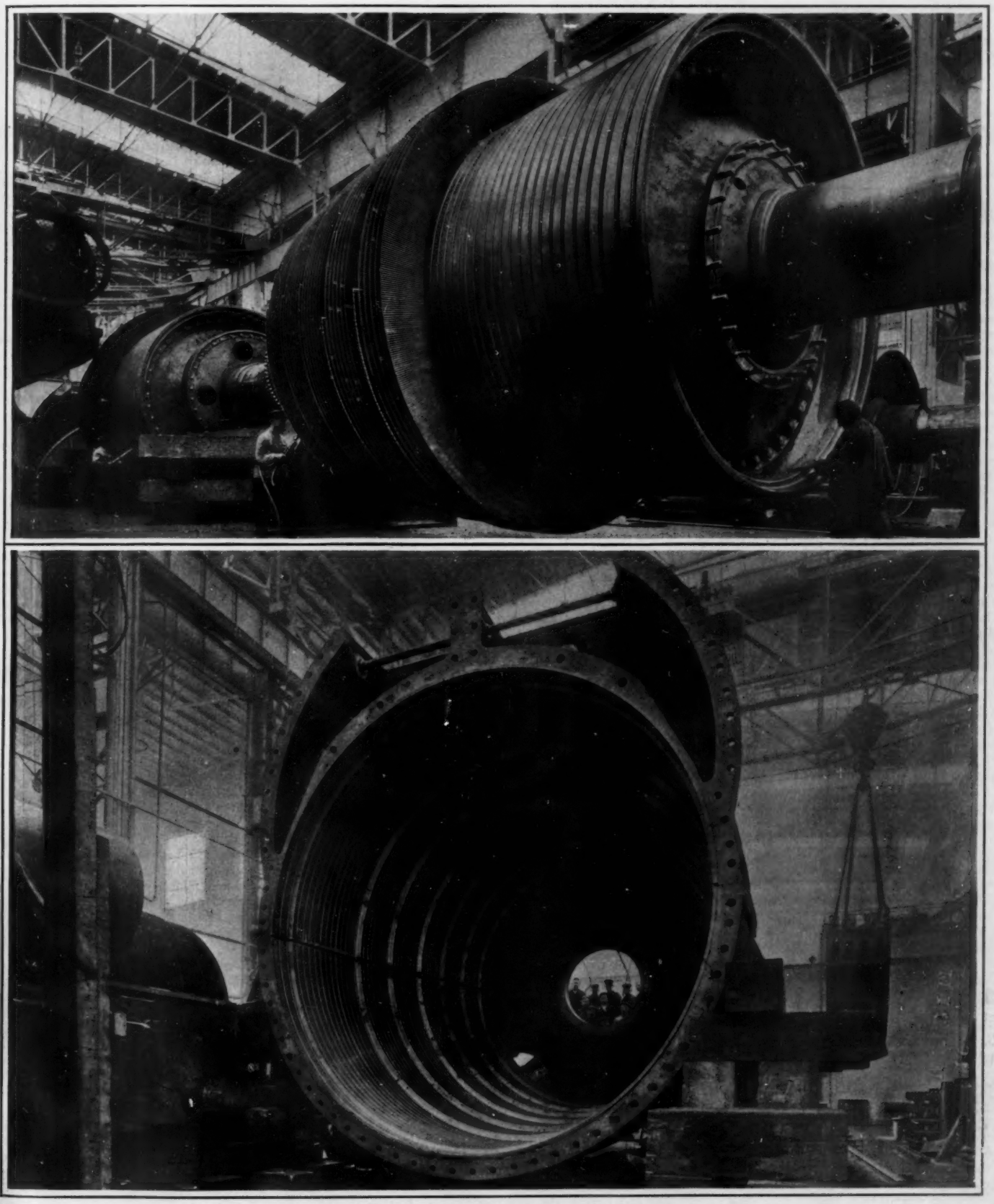

The rotor contains fifty thousand blades. The casing is eighteen feet diameter and twenty-five feet long.

THE LOW-PRESSURE TURBINE OF THE "IMPERATOR."—[See page 5.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

High Speed Through the Ice Fields

THE Board of Trade inquiry into the loss of the "Titanic," which is being held under Lord Mersey, naturally is eliciting more detailed evidence than it was possible to gather during the necessarily limited investigation by our Senate Committee. Thus far, some very startling testimony has been given (startling at least to the lay mind) by certain of the more important witnesses. Mr. Ismay, for instance, gave an unqualified endorsement of the course followed by Capt. Smith, of the "Titanic," in proceeding at full speed after he had received several warnings that there was heavy ice ahead of the ship. The witness made the point that, by traveling at high speed, the "Titanic" would have been sooner through the zone of danger and out in clear water again. The argument is familiar. We have heard the same thing said in justification of traveling at high speed through a belt of fog.

So important is this testimony in the light which it throws on the risks of transatlantic travel, that we have made personal inquiry among the navigating officers of several first-class passenger ships; and we find that if the weather is clear, it is the universal practice not to slow down the ship, even though it be well known, through wireless despatches, that there is a field of ice ahead. "We never stop for ice in clear weather," said one officer of an English ship. "The course followed by Capt. Smith was perfectly justified," was the comment of the leading officer on one of the fastest German ships. Indeed, the consensus of this expert opinion, without an exception, justified the high speed of the "Titanic," as being in accordance with the recognized practice under such conditions on the bridge of all transatlantic steamships. It seems to be universally held that, if a good lookout is kept on such a clear night as that of April 14th, it is practically impossible to avoid seeing an iceberg, long before it gets into dangerous proximity to the ship. Obviously, then, one of the lessons of this disaster is that now and again, even though the night be clear, there will occur conditions, such as a smooth sea and an iceberg of a color that approximates to the general coloring of the sea, which may make it impossible to detect the ice in time to avoid collision, and so may render a repetition of the "Titanic" disaster inevitable.

It would seem from testimony given before the Board of Trade that conditions did render it extremely difficult to see this particular iceberg. One officer of the "Titanic" testified "everything was against us," meaning that the size of the iceberg, its color and the absence of broken water at its base, made it practically impossible to detect the obstruction until it was close aboard.

In our investigation, above referred to, we found a consensus of opinion, also, that the chances of avoiding the ice when it was once sighted were as good, if not better, when the ship was running at high speed than when she was running under a slow bell; it being claimed that the ship would answer her helm more quickly at high than she would at low speed; which is undoubtedly true.

Now, since the steamship companies wish their ships to be run at full speed, if possible, all the way across the Atlantic; since the officers in command of the ships are unanimously in favor of high speed; and since the public, except when it is in a panic over some portentous disaster, is certainly in favor of high speed; it is safe to assume that speed will not be slackened in the future, either in fog or among icebergs. Ships weighing from 40,000 to 70,000 tons will continue to go hurtling their way across the Atlantic, whether by night or by day, trusting to the sharp eye and the steady hand to avert disaster. Evidently, if travel is to be made absolutely safe, that is to say, if the "Titanics" of the future are not occasionally to be sent to the bottom at short warning, carrying a multitude of people with them, something should be done to make the ship unsinkable under those special conditions when "everything is against" the ship and the keen eye and the steady hand are not sufficient to prevent catastrophe.

The Board of Trade inquiry now going on in London will fail pitifully of its purpose, if it does not make such changes in the laws governing the structural requirements for safety in future ships as shall make them practically unsinkable by collision, whether with another ship, as in the case of the "Republic," or with ice, as in the case of the "Titanic," or with the derelict, as in the case of many a good ship that has sailed and never been heard of again.

Battle Efficiency and Navy Appropriations

THE reluctance of the House of Representatives to provide the necessary appropriations to carry out the very reasonable program for maintaining our Navy at its proper relative strength, looks like a very poor recognition of the high state of efficiency to which our existing fleets have been carried.

There may be other departments of the Government which can show an equal rate of improvement; but we are certain that there are none which can excel the record which has been made during the past two or three years by our Navy Department.

At the last analysis, the object of the money which has been spent and the infinite care, thought, patience, and hard work, which have so markedly characterized every branch of the Navy Department, is the maintenance on the high seas of a fleet of battleships and cruisers, characterized by the highest efficiency, and at all times ready for immediate action at the call of the Government.

Everyone who is at all familiar with conditions in the Navy to-day knows that this efficiency has been realized beyond the most sanguine expectations. Not only are the latest battleships which have gone into commission among the most powerful and most completely protected in the world, but the efficiency of these ships, as shown in target practice under battle conditions, is such as to warrant the belief that our gunners lead the world in the accuracy and rapidity of their fire at the longest ranges.

The fighting efficiency of our battleships of to-day, as compared with that of the fleet which fought under Sampson and Schley during the Spanish-American war, shows an improvement which is scarcely believable except by those who, like the writer, have had an opportunity to witness the work of the fleet from one of the battleships engaged. This improvement has been succinctly stated by Mr. Meyer, the Secretary of the Navy, more than once during the past few months. A comparison shows that, whereas the percentage of hits in 1898 was 3½ with the large guns, firing about once in five minutes at short range, the percentage of hits in the firing last year at the San Marcos was 33 1/3, the range being 10,000 yards, and the present rate of firing a single 12-inch gun being about ten shots in five minutes. This rather overestimates the work at Santiago and underestimates the work to-day. A roughly drawn comparison shows that we are about 1,200 times better in gunnery efficiency than we were at Santiago.

So far then as the ability of our battleships and cruisers to hit the enemy hard and often at great ranges is concerned, it is certain, if we may adopt a current phrase, that the country is "getting its money's worth." If the pruning knife of economy must be used, it would be wise, surely, to spare a tree which is yielding such abundant fruit.

A New Method of Testing Coal

AS a test of the value and character of fuel, the discovery of the amount of volatile matter in coal is unquestionably of the very greatest importance. This is estimated by finding the loss in weight of about fifteen grains of a sample, by bringing it to a high temperature in a platinum dish. This simple procedure really gives more information than any detailed chemical or calorimetric analysis.

However, the complete accuracy of the test is not always possible. The weight, length, breadth, and intensity of the flame and the heat, as well as the platinum receptacle which holds the sample, the sort of gas and burner, the distance, time, and other conditions, all have some effect upon the results, that is upon the residue left and the volatile matters driven off.

The committee on coal analysis of the American Chemical Society over twelve years ago made an exhaustive study of various practical methods, and brought in a report that the method of quantitatively finding the amount of volatile substances lost, was a fairly uniform plan to follow.

Usually the coke left behind is neglected or altogether ignored. The coking or swelling of the residue may be mentioned, but no discussion of the kind or character of the coal enters into consideration.

Dr. R. Lessing has just announced to the London Society of Chemical Industry a novel apparatus and plan, which will give a more correct estimate of the difference in the coke produced from various coals, and which will account for the process of carbonization in all cases. It will show a qualitative distinction between the various types of coal, and eliminate the fallacies of the old method, the platinum dish test.

The sources of error in the old method may be said to be, first, elements which raised the volatile value, such as combustion of coke in the air rich in oxygen, and flickering coal dust due to the explosive gases of certain coals and rush of air currents caused by the flames. Secondly, the elements that decrease the volatile value, such as cessation of the action before the coal is thoroughly coked, deposit of the volatile materials on the walls of the platinum crucible, and decomposition of volatile substances by radiation.

The secondary breaking up of volatile substances, depends on the breadth of surface with which they come in contact. The coal in the platinum crucible is spread in a very thin layer. It takes up less than one tenth of the whole space. The gas and tar vapors touch a broader area than is good. In order to avoid the errors caused by waste space over the coal, and too much heated surface in contact with the gas and other volatile products in the crucible test, Dr. Lessing prefers to conduct his analysis with a small cylindrical vessel. He applies the heat to the coal itself, and not to the volatile products. By introducing a piston which rests on the powdered coal and fits loosely into the outer cylinder, all waste space is prevented, and all gases and vapors are allowed free play.

Dr. Lessing's apparatus consists of a heating tube, a quartz glass cylinder. This non-conducting medium may have an electric resistance coil of platinum wire wound directly around it. Numerous glass pin points are fused on this tube to keep the turns of the platinum coil apart. In order to concentrate the heat where it is required, the platinum wire is first wound to a close coil and this is wound around the cylinder tube. The coil attaches itself by its own elasticity. The coils are close at the bottom of the cylinder, getting wider and wider apart, so that the heat is just enough to keep the coal tar volatilized. Another "reacting" glass vessel fits loosely into the other "heating" tube. Its interval diameter is about one third of an inch.

Fifteen grains of the powdered coal are placed in the inner tube, and into a third tube which telescopes into the other inner tube. By altering the weight of this innermost tube or filling it with different amounts of quartz powder, during the test various pressures may be exerted on the coal.

The outermost tube is buried in an insulating substance such as kieselguhr. A rheostat combined with the furnace allows various changes of resistance and the temperature may be accordingly altered.

The test is made, by weighing the coal into the middle tube. Then the innermost tube is inserted over this and the two placed within the outside, insulated tube. As the current is turned into the platinum coil, the temperature slowly rises, allowing the gradations and steps of carbonization to be recorded. First, free moisture, then occluded gases, soon to be followed by tarry vapors, will be seen increasing in volume. All this depends upon the kind of coal tested. The heavier liquid tars and pitches condense on the cold parts of the innermost tube. The whole test requires about six minutes, and is then permitted to cool. The coke obtained shows the character of the coal.

Dr. Lessing's simple device also serves to identify the individual differences of each kind of coal. Any particular kind of coal will give at all times when treated under the same conditions, a coke identical in all respects with another specimen produced from the same sample.

"Although the principal consideration in designing the apparatus," says Dr. Lessing, "is to obtain a means for generally studying bituminous coals as fuel, satisfactory results have been obtained when employing it for a quantitative estimation of volatile matter.

Limits of Natural Vision.—The limits of vision vary with elevation, condition of the atmosphere, intensity of illumination and other modifying elements in different cases. On a clear day an object one foot above a level plain may be seen at the distance of 1.31 mile, one 10 feet high 4.15 miles, one 20 feet high 5.86 miles, one 100 feet high 12.1 miles; one a mile high, as the top of a mountain, 95.23 miles. This allows 7 inches, or, to be exact, 6.99 inches for the curvature of the earth, and assumes that the size and illumination of the object are sufficient to produce an image.—*Scientific Digest.*

Electricity

Chemical Effect of X-Rays.—As definitely proving the chemical effect of the X-rays, it is reported that when solutions of starch are irradiated for several hours by X-rays of moderate penetrative power, the starch is partially converted into soluble starch and dextrin, and the opacity and viscosity of the solution are markedly reduced. An exposure of 8½ hours caused the transformation of about 5 per cent of the starch into dextrin.

The Montefiore Prize.—The conditions for the triennial Montefiore prize for the 1914 concourse are the following. The prize consisting of 3 per cent interest upon a Belgian fund of $50,000, will be awarded every three years to the best original work presented upon scientific advancement and the progress made in technical applications of electricity in all departments, excluding popular treatises or simple compilations. This award is known as the George Montefiore Levi prize, and the jury is formed of ten electrical engineers, five home and five foreign, presided over by the chief professor of the Montefiore electro-technical institute. The last date for receiving contributions for the concourse is March 31st, 1914, and further information can be obtained from the secretary of the Montefiore association at Liege, Belgium, 31 rue Saint-Gilles.

Accuracy of Electric Meters Under Intermittent Loads.—Certain critical consumers of electrical energy who have noted that their electric meters keep on running for one or two seconds after the lights are turned out or the elevator or other motor is shut down, may have imagined that their meters were overcharging them by this action. These persons can have their fears allayed by the conclusions of a paper on "Electrical Meters under Variable Loads," recently read before the British Institution of Electrical Engineers, viz., that errors due to intermittent loads are relatively small in meters of the type generally used in the United States, designed with the Foucault braking disk. The fact is liable to be overlooked that the inertia of the meter, which causes the latter to run for a moment after the current is interrupted, will also tend to prevent the meter from starting for a moment after the circuit is closed.

Electricity from Peat.—European engineers are engaged at present in the investigation of methods of utilizing peat as fuel in electric stations. Southern Bavaria, for instance, has vast peat fields which would serve to run electric plants of large size and this would give a great reserve of power The peat bogs lie mainly in the region of the Danube, and are estimated to cover an area of 500 square miles. Supposing the peat layer to be only 3 feet in thickness and the cubic foot of peat to afford but 3 pounds of fuel, this will mean a supply of 50 million tons. With the operation of extracting the peat regularly carried on during the year for 300 days, this can afford 700,000 horse-power in the space of 50 years. The fuel can be burned under boilers or it can be used in special producers to secure a supply of gas for industrial purposes.

Hydro-electric Plants in Iceland.—Iceland possesses a large amount of power in the shape of waterfalls, and for some time past the question of obtaining an electrical supply from them has been under consideration, but what makes the matter difficult is that most of the falls lie at great distances from the coast and are far from the centers of population. There are however many other falls which could be utilized. Quite recently a French syndicate purchased a large extent of ground in the neighborhood of Thorlakshaven, as well as several large waterfalls situated in the mountain regions in the interior. It is stated that the falls will be able to furnish as much as 200,000 horse-power. The present syndicate is to construct a good port upon its ground and it will furnish a supply of current to different industries which are situated in this district. One of the newest enterprises will be the construction of works for manufacturing nitrogenous products on the Birkeland-Eyde electric system.

Electric Light Service in Denmark.—According to recent information about the progress of electric light and power industries in Denmark, it appears that all the towns of 5,000 inhabitants and over are now provided with public electric service. As to towns lying between 5,000 and 3,000 inhabitants, there are only three in which electric mains are not installed, so that it will be seen that Denmark is one of the most progressive countries in this respect. The largest sized electric stations are to be found at Copenhagen, and at present there are three large plants in operation giving a total of 27,000 horse-power. Current is supplied for the city mains as well as for the tramway lines. As regards the Danish stations in small towns, in general each town has its own plant, and there is but one example of an intercommunal system. This is at Skovshoved, near Copenhagen, and the central station extends its power lines over all the suburban region also supplying the tramways of Hellerup and Klampenburg. In most of the town electric stations the Diesel heavy oil engine is used.

Science

A Russian North Polar Expedition is being planned by Capt. Ssedow, who has had considerable experience in exploring under Arctic conditions, having led an expedition to the mouth of the Kolyma in 1909, and one to Nova Zembla in 1910. Ssedow proposes to proceed in a ship to Franz Josef Land, and thence to attempt a sledge journey over the ice to Greenland, by way of the pole. He has announced his intention of naming any land he may find near the pole "Nicholas II Land," and thus counts on securing the patriotic support of the Russians to his undertaking. There has been some talk in the Russian Duma of providing the explorer with a government vessel, to be especially constructed for ice-crushing, in accordance with an old plan of the late Admiral Makaroff.

The Australasian Antarctic Expedition, under Dr. Mawson, has not only proved the existence, over a distance of some 1,200 miles, of Wilkes Land, which has been a bone of contention between American and European geographers for seventy-odd years, but has actually landed two parties on it; one, under Mawson himself, nearly at the east end of this coast, at Point Alden, in the eastern part of Adelie Land; the other, under Mr. Wild, about 1,200 miles farther west, in the part of the coast that was named by Wilkes Termination Land, and that has hitherto been either ignored or marked with a note of interrogation on all European maps. The landing of Mr. Wild's party was accomplished with great difficulty, on the precipitous ice-cliff of a glacier about 100 feet high. A year's stores had to be hoisted to the top by means of shear-legs. Besides these two parties in Antarctica, the expedition landed five men at Macquarie Island, where a wireless telegraph station was installed. The "Aurora," the ship of the expedition. finally sailed back to civilization, and will return to relieve the exploring parties in the southern summer of 1912-13. Meantime, she will carry on oceanographic research—for which she is specially equipped—to the south of Australia.

Sea Routes to Siberia.—Contrary to previous reports, it now appears that the plans of the English captain, Webster, to establish regular steamship communication between European ports and northwestern Siberia by way of the Arctic Ocean and Kara Sea have been disapproved by the Russian government, obviously for the reason that this bold undertaking, which appeared to be entirely feasible, would have diverted considerable traffic from the trans-Siberian railway. On the other hand, the Russian authorities are furthering in every way the establishment of communication by sea between Pacific ports and northwestern Siberia, *via* Bering Strait. A surveying party, under Capt. Grünfeld, has proceeded from Yakutsk to Nishni Kolymsk, at the mouth of the Kolyma River, to make a thorough investigation of that port, and the geologist, J. P. Tolmatschew, will study the conditions of navigation between the mouths of the Kolyma and the Lena, including an examination of the Lena delta, with a view to establishing a sea route to the latter region. The ice-breakers "Taimyr" and "Waigatsch" were to leave Vladivostok in May for a surveying expedition along the coast of Kamtchatka, after which they will proceed *via* Bering Strait to the Arctic coast of Siberia for a cruise at least as far west as the Lena. If ice conditions prove favorable these vessels will attempt to pass Cape Chelyuskin and accomplish the northeast passage to the European port of Archangel.

An Elixir of Life.—At a recent meeting of the French Academy of Sciences, Prof. Metchnikoff, Director of the Pasteur Institute, gave a fascinating account of another advance in his struggle against the factors causing senility. Recent scientific research has shown the natural decay of the human body to be brought about by the bacterial flora of the intestines. The fact that the Bulgarian peasants feeding partly on yoghurt, a fermented product of cow milk, reach an astounding longevity, is accounted for by the invasion of beneficent bacteria taking the place of the harmful inhabitants of our digestive organs. Arteriosclerosis, sclerosis of the liver and an inflammation of the kidneys are the three maladies produced according to Metchnikoff by the poisonous action of our bacteria. Experiments on animals have shown the two toxins *indol* and *phenol*, which are responsible for this poisoning of the body, to be eliminated by food rich in sugar, such as dates, bananas, etc., the sugar destroying the poison. As, however, the sugar, being absorbed in the upper parts of the intestines, does not penetrate as far as the large intestine, which contains these dangerous toxins, means had to be designed for introducing sugar into that part of the alimentary canal. Such a means has now been found in a beneficent microbe derived from the bacterial flora of dogs and which, especially if assisted by an abundant consumption of potatoes and by some lactic ferment, will prevent the production of toxin. These experiments, in Prof. Metchnikoff's own words, are the first step toward the conversion of our bacterial vegetation from a "wild" flora into a cultivated harmless flora.

Aeronautics

The Death of Harry Turner.—Harry Turner, a nineteen-year-old mechanic in the employ of an aviator in Mineola, was killed recently in his employer's machine. He was making a circle above the field when he attempted to descend. It is not very clear how the accident occurred. Apparently it was due to bad handling.

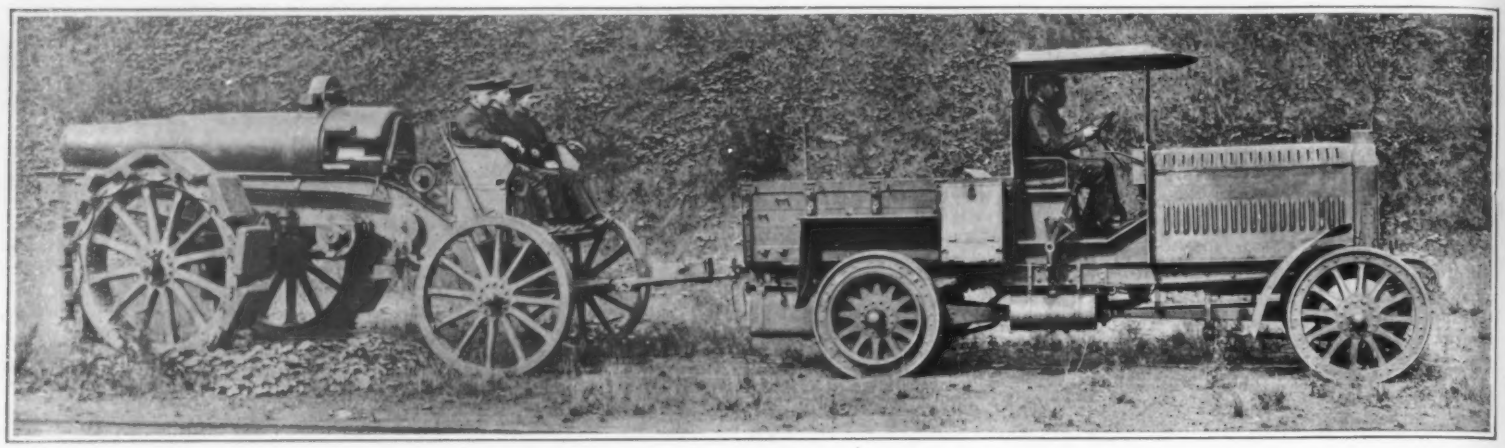
The First Navy Zeppelin.—The German navy is to have its first Zeppelin airship. Hitherto, the rigid dirigibles of Count Zeppelin have been used by the army and by a private company for the transportation of passengers. In its official tests, the navy Zeppelin will be required to remain aloft continuously for twenty hours and to carry one ton of explosives. Most of the Zeppelins are now equipped with wireless apparatus.

A Parachute Drop from an Aeroplane.—The first successful parachute drop from a flying machine was made on Long Island by a venturesome young man named Law, who has been startling the residents of New York by leaping from tall buildings, in a parachute. Law went up with an aviator in a biplane. The parachute was attached to the under side of the lower plane. While the accounts that have been given of the exploit are not very clear, it seems that Law crawled under the plane hand over hand until he managed to seize the parachute.

Some Recent German Aviation Exploits.—It is curious that we hear so little in this country of some of the more remarkable achievements of German aviators. How many people in this country know of the recent flight from Berlin to Vienna by Hirth with a passenger, in which a mountain range 4,500 feet high was crossed and in which an average speed of more than sixty miles an hour was maintained? It may interest those readers of the SCIENTIFIC AMERICAN who have been following our articles on the GOULD-SCIENTIFIC AMERICAN Prize that the machine was equipped with two motors and two propellers.

Aviation Insurance.—According to United States Consul General A. M. Thackara of Berlin, the business of insuring the limbs and lives of aviators is not very prosperous in Germany. The rate for the insurance of those who go up in balloons and dirigibles has recently been increased, while insurance for those who go up in aeroplanes is simply unobtainable. "None of the local companies will now quote rates for the insurance of aviators against death. The rates for accident insurance for aviators are $2.38 for a $238 policy and $4.76 for a policy yielding a daily remuneration of twenty-four cents during invalidity. The rates for the insurance of aviators against liability for damages arising from injury to other persons range from $29.75 for a policy paying a maximum of $5,950 when one person is injured or $17,850 when more than one is injured, to $47.60 for a maximum of $23,800 for one or $71,400 for more than one person injured. The rate for insurance against liability for damages to property is 20 per cent of the policy when damages from fire or explosion are not included and 30 per cent when such damages are included. The minimum premium is $2.38 and the maximum liability $2,380. The rules governing this form of insurance are in general the same as those usually covering other forms of insurance against liability for damages. Insurance against accident of those who go up in motorless balloons as in the case of aeroplane accident insurance is usually written in connection with ordinary accident insurance. The rates for this combined insurance are the same as for ordinary accident insurance plus the rate quoted above."

The Naval Aeroplane.—In a book entitled "Aviation in the Navy," Lieut. E. Lapointe of the French navy discusses the relative merits of the hydro-aeroplane and of the aeroplane which starts from and alights on the deck of a battleship. He points out that the hydro-aeroplane is not favored by sailors because it is useful only in absolutely still water. To alight on the water, he argues, is no great advantage except perhaps for a great aeroplane acting independently of a ship and attempting to make a protracted cruise. He proposes that a competition be held for a naval aeroplane which, by means of special floats, watertight bodies, or even fixed wings serving as floats, has the ability to float on a moderate sea and in a moderate breeze for several hours without injury to passengers or machinery. The motor must be of such construction that, after several hours in this position, it can be overhauled and put in operation in a few minutes. It must be possible to hoist the machine from the water and land it on a ship's deck by the ship's crane. It must be able to start from or land upon the shore under ordinary conditions. Lieut. Lapointe distinguishes between an aeroplane scout to carry two passengers, a pilot and an observer, for three hours with an extra weight of 100 pounds, giving a total weight carried of 400 pounds, exclusive of necessary oil and gasoline for the motor, and an aeroplane cruiser which shall carry three passengers, a pilot, a mechanic and an observer, for at least five hours, with an extra load of 200 pounds, giving a total weight carried of 670 pounds, exclusive of necessary oil and gasoline for the motor.



The 11-inch howitzer is hauled by motor cars.

A New Type of Powerful Mortar

The Krupp Eleven-inch Howitzer and Portable Carriage

By the English Correspondent of the Scientific American

OWING to the development that has taken place in the design and construction of protective works in connection with fortifications, where ever-increasing strength is secured to the point almost of invulnerability, there has been a demand for more powerful and heavier weapons of attack. There is no doubt but that in the next war between any two of the foremost powers, greater stress will be laid upon the artillery. The war between Russia and Japan emphasized this factor to a convincing degree when, although the Japanese brought the latest skill in military science to bear upon Port Arthur, they made but little impression with their fire upon the permanent works. This attack was remarkable for the fact that in the attack the Japanese employed the heaviest arm that has ever been directed against fortifications—a 28-centimeter or 11-inch mortar.

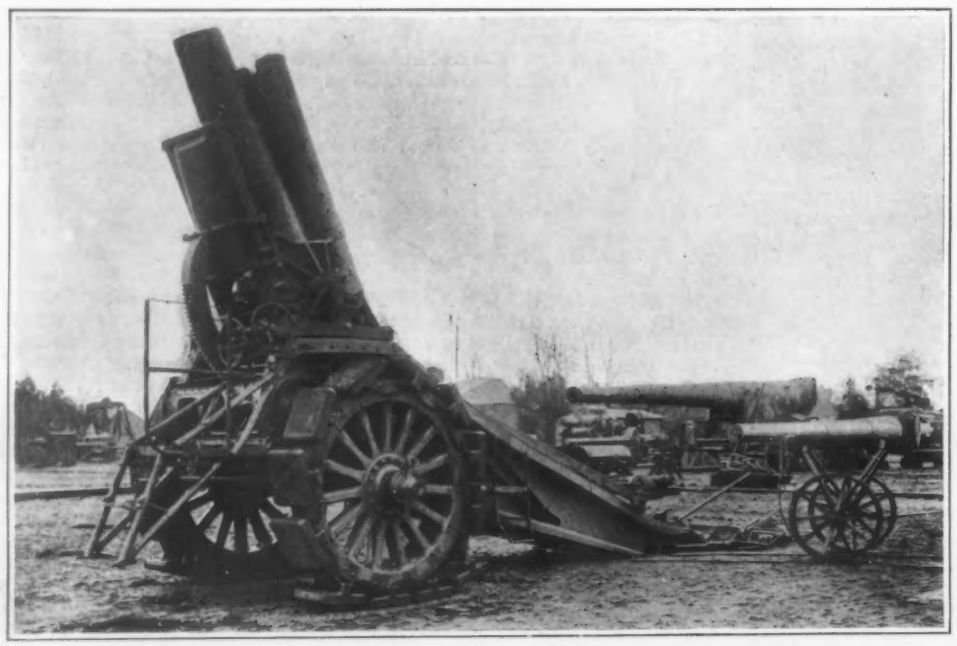
In Russia, Austria-Hungary and France weapons of this type of 23, 24, and 27 centimeters, respectively, are in service, but in every instance they are practically permanent defense pieces, demanding a solid firing platform. Accordingly, if the occasion arises for the arm to be removed from one point to another, the operation is one of great difficulty and occupies considerable time.

Realizing this deficiency in mobility, the Krupp firm has designed a new type of mortar of this character, the outstanding feature of which is that it is mounted upon a gun carriage, so that it can be moved from point to point, and can even be attached to the artillery in field operations. This end is achieved without any sacrifice of ballistic efficiency, by the application of a long invariable recoil, and by the employment of wheels fitted with feet after the manner of the Diplock pedrail.

The Krupp designation of this piece as a howitzer is to distinguish it from the mortar proper, reserving the latter title for those weapons able to fire at an angle exceeding 45 degrees. This new arm has a greater variation in its elevation, so that it really is more flexible in use. The two terms however are now so generally confounded that it may be classed as a mortar.

The barrel is made of steel and comprises the inner bore and a jacket, the total length being 11 feet. The opening and closing of the breech is effected by turning a handle through a horizontal arc for about 135 degrees, and there is a safety device operated by hand to prevent premature firing or the accidental opening of the breech. After the discharge, the spent cartridge is automatically ejected by the opening of the breech block. Owing to the principle of construction, the opening and closing of the breech can be effected easily by one hand and in a few seconds, notwithstanding that it weighs over 1,100 pounds.

The carriage upon which the arm is mounted comprises in reality two vehicles. The barrel or mortar proper is carried upon one carriage, while the other carries the mounting with the recoil brake and the two air reservoirs. In transport the two pieces are hauled separately, the main wheels of each carriage being shod with feet, so as to permit passage over soft ground without sinking, while haulage is carried out by gasoline motor cars, as being more suited to the work than horses. Upon arriving at the position of firing, the mounting carriage is planted first, and then the second carriage is moved up from the rear, until the bore is in line with the cradle of the mounting. By means of thin wire cables and pulleys the mortar is pulled from its own carriage, and slides over special guides through the opening in the second carriage, until it is in the designed position, where it is made fast and connected up. The second carriage is then withdrawn, leaving the arm complete upon the mounting carriage and ready for firing.



The mortar being transferred from its transport cradle to the mounting.

Bore, 11 inches; length, 11 feet; shell, 136 pounds; powder, 38 pounds; maximum elevation, 65 degrees; maximum range at 65 degrees 24,278 feet; maximum range at 42½ degrees, 33,135 feet.

A mobile 11-inch mortar for field service.

The training gear gives a maximum elevation to the mortar of 65 degrees and works upon a rapid system. The weapon can also be moved 5 degrees on either side in the horizontal plane. The upper part of the cradle into which the bore slides carries a group of three cylinders. The central cylinder is the recoil brake, while that on either side is an air reservoir. The recoil brake differs from the type adopted in connection with field guns. The gun is not connected to the brake cylinders but to the piston rod. Consequently, it is the piston rod and the piston which move in the recoil of the gun, the brake cylinder remaining stationary. The air reservoirs consist essentially of an air cylinder, a ram with piston rod and piston, and valves.

The howitzer fires a shell weighing 136 pounds, and the charging of the weapon requires the aid of six or eight men, the explosive charge weighing 38 pounds. By using one of eight different charges, it is possible to vary the initial velocity from 590 to 1,115 feet per second. It is possible to secure, with all distances exceeding 7,218 feet a falling angle for the shell exceeding 22 degrees. The weight of the projectile is more than twice that of the next most powerful weapon of its class, while its range is 20 per cent higher.

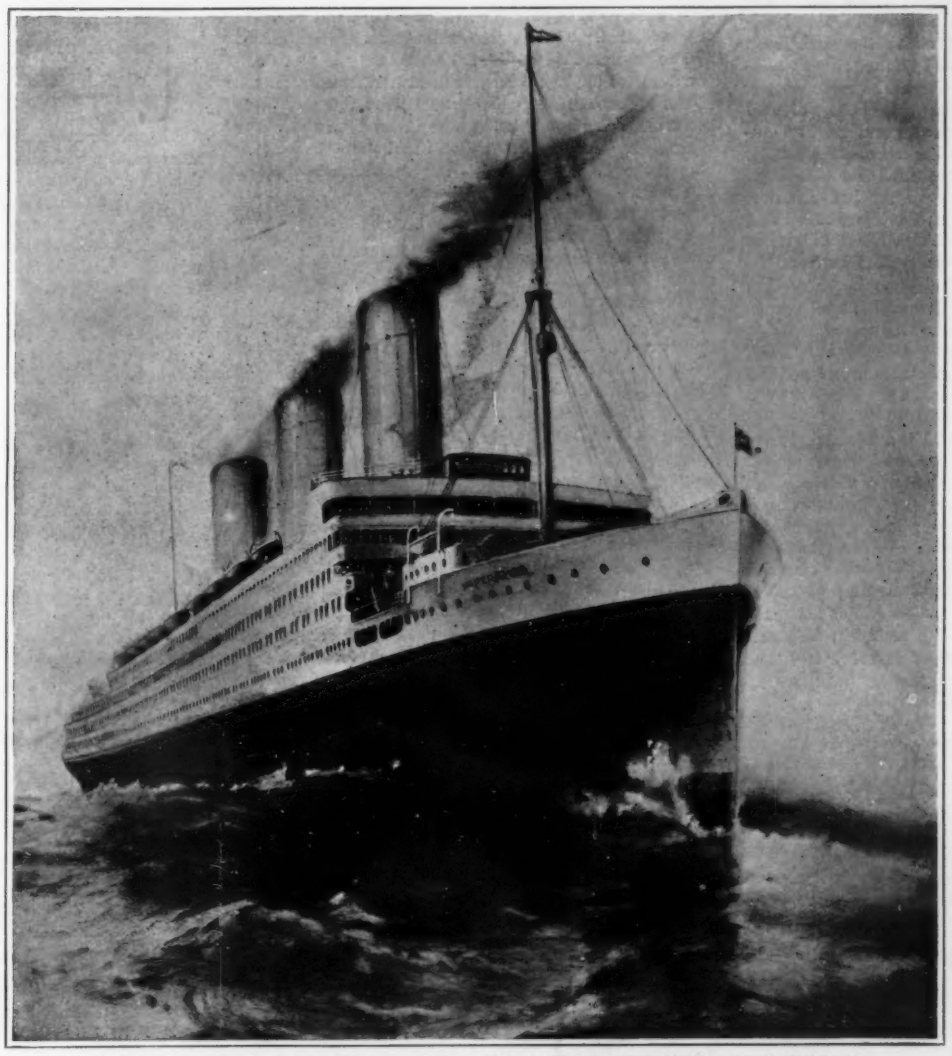
The Largest Ship Yet Constructed

The Launch of the 65,000 Ton Liner "Imperator"

WITH the loss of the "Titanic" fresh in the public mind, special interest attaches to the recent launch of the "Imperator," which exceeds that huge vessel by some 5,000 tons. The ship is being built for the Hamburg-American Company at the Vulcan Yard at Hamburg, and the ceremony of naming the ship at the launching was performed by the Kaiser, whose interest in the German merchant marine is second only to that which he has shown in the upbuilding of the German navy.

The length of the "Imperator" is 900 feet, and she thus has the distinction of being the first ship to come within 100 feet of the 1,000-foot ship of which naval architects have been wont to speak in late years in naming the possibilities of length which might be reached before many years have passed. Her beam is 96 feet and her molded depth 62 feet. From the keel to the boat deck will be 100 feet and the distance from the keel to the trucks of the masts will be 246 feet. The three funnels will be oval in section, measuring 18 feet on the smaller and 29 feet on the greater axis. The rudder will weigh 90 tons and the diameter of the rudder stock will be 2½ feet.

The ship will be driven by turbines of 70,000 horsepower which will be developed on four shafts, and the estimated speed of the ship is 22½ knots. She will be equipped with water-tube boilers.

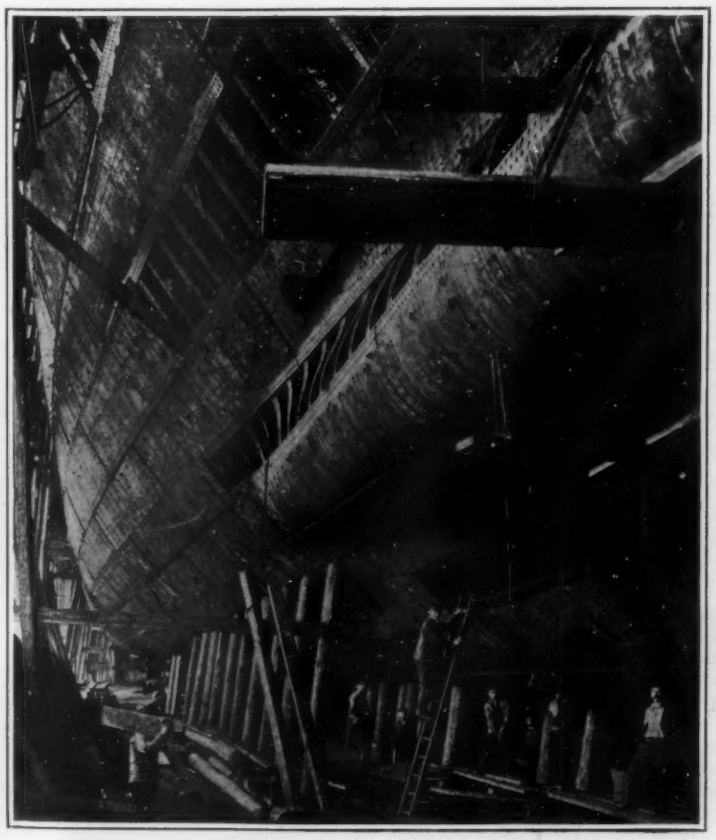


Length, 900 feet. **Beam,** 96 feet. **Displacement,** 65,000 tons. **Horse-power,** 70,000. **Speed,** 22½ knots. **Passenger capacity,** 4,100. **Crew,** 1,100.

The "Imperator"—largest ship afloat to-day.

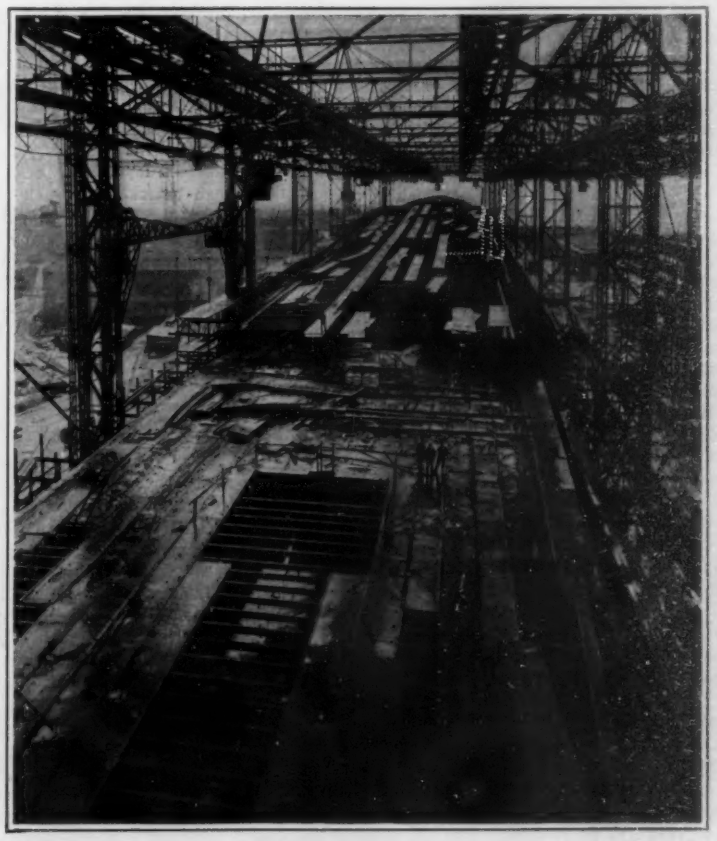
A feature of the ship which will be appreciated by passengers is that she will be fitted with the Frahm anti-rolling tanks, otherwise known from their shape as "U" tanks. This device consists of tanks of large capacity, built on opposite sides of the vessel and connected by an inclosed waterway, through which the water can flow from side to side of the ship as she rolls, its flow being subject to control by valves. Experience in the few passenger ships which have been thus equipped has shown the Frahm tanks to be the most efficient anti-rolling device yet tried.

With the "Titanic" disaster so recent a fact, the questions which at once arise with regard to the "Imperator" are those relating to her internal construction and particularly her construction below the water line. What provision has been made for meeting such a devastating accident as that which sent the huge "Titanic" to the bottom in two hours and thirty minutes? It will be remembered that in our article in the SCIENTIFIC AMERICAN of May 11th, we advocated either the use of a double skin below the water line, or the construction of longitudinal bulkheads to inclose coal bunkers carried along the sides of the vessel in the



Swelled out portion contains wing propeller shaft

Riveting the outer skin upon the after part of the ship.

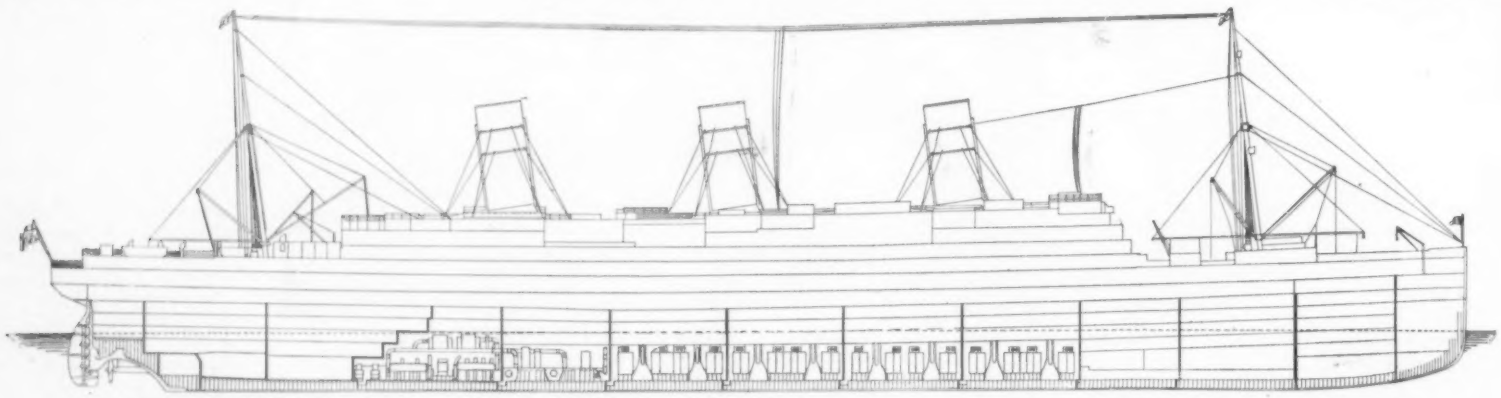


Note the enormous length of this deck. The men in the forground afford a scale of size.

Laying the steel plating upon the deck beams.

wake of the boiler rooms. The sub-division of the "Imperator" below the water line has been carried out under the supervision of the Germanic Lloyd's and the Immigration authorities. It consists of a series of intersecting transverse and longitudinal bulkheads. Transversely, the ship is subdivided by twelve bulkheads, which are carried two decks above the water line, with the exception of the collision bulkhead forward, which extends four decks above the same level. These bulkheads are intersected by longitudinal bulkheads, which subdivide the boiler and engine rooms, the under water portion of the ship being divided altogether into twenty-four separate watertight compartments. There are four boiler rooms, containing the water-tube boilers, the type used on this ship. The coal bunkers are placed above the boiler rooms, and along the sides of the ship, in the latter case being known as wing bunkers. The longitudinal bulkheads are placed about nineteen or twenty feet in from the side of the ship, and they extend from bulkhead No. 4, aft to bulkhead No. 8. Astern of the aftermost boiler room is the forward turbine engine room, which is protected against flooding by two wing bulkheads, between which and the sides of the ship are placed the auxiliaries. The after turbine room is divided by a central longitudinal bulkhead.

Because of its great size, special interest attaches to the turbine installation. We present illustrations of one of the low-pressure turbines, from which one can gain a vivid impression of the great size and weight of the various parts. The rotor, or rotating part, contains 50,000 blades, and is capable of developing over 22,000 horse-power. The casing is 18 feet in diameter and 25 feet long. The shafting of all four propellers is 1½ feet in diameter. The propellers, which are made of turbadium bronze, are 16 feet 8 inches in diameter. Although the engines are spoken of as being of 70,000 horse-power, it is probable that on test they will develop from 80,000 to 85,000 horse-power.



The transverse bulkheads amidship are carried two decks above the water line, the height increasing toward the ends. There are twenty-four watertight compartments below water.

Inboard profile of the "Imperator."

The German government, in its supervision of the construction of passenger-carrying ships, pays as much attention to the question of fire-protection as it does to that of protection against sinking at sea. The tiers of passenger decks on a huge ship of the size of the "Imperator" are filled with a great amount of material of a highly combustible character, such as wainscotting, passenger stateroom partitions, paint, varnish, and general architectural embellishment. This material would afford highly inflammable fuel, should a fire once obtain a strong hold upon the ship; and the long alleyways, if they were not shut off at intervals by the screens, would afford an easy means for the spread of fire throughout the full length of the deck. To prevent this, light steel bulkheads are run from side to side of the ship throughout the passenger accommodation spaces. They are provided with fire doors and drills are held at regular intervals, in which the fire mains are in full service, and the work of closing the smoke doors is carried through by such members of the crew as are detailed for this work.

We are informed by the Hamburg-American Company that the "Imperator" will probably make her maiden trip to New York in the early summer of 1913.

The Interferometer Barograph

A NEW device for observing and measuring minute fluctuations in atmospheric pressure is described by Prof. Albert C. Crehore and Major George O. Squier, U. S. A., in the *Bulletin of the Mount Weather Observatory*. The detection of these fluctuations, which occur unceasingly, is a problem that is attracting increasing attention, both from meteorologists and aeronauts. The first apparatus for the purpose was the Shaw-Dines microbarograph; another was the variograph, introduced two years ago by Schmidt. The principle of the Crehore-Squier instrument, however, is entirely new. The apparatus includes a set of eight standard aneroid cells, from which the air is exhausted, such as are used in the familiar Richard barograph. In the latter the recording apparatus consists of a system of mechanical levers and a pen, registering on a revolving cylinder. The "lost motion" attending any such combination of levers and pivots in the nature of things obliterates all of the delicate and rapid motions that would occur in the cells if they were disconnected from the recording apparatus, so that only the grosser changes of pressure are indicated. The new instrument makes its record by the interference of light. A plane glass plate, silvered on its upper surface, is fixed horizontally on top of the uppermost aneroid cell, and rises and falls with it. A second glass plate, thinly silvered on the under side, is fixed rigidly above and parallel to the moving plate; the two plates form the interference system. The source of light is a mercury vapor lamp placed almost directly above the interference plates. A camera is so adjusted as to photograph the circular interference bands through a slit, the resulting image being a strip along a diameter of the circles. The image is impressed upon a film moving at a uniform rate. As the circles expand and contract, with changes in pressure, each interference band makes its record as a wavy or sinuous line. The exact time is registered on the film by the device of interrupting the light for an instant at the end of each minute. The motion of the cells is magnified, by this device, about 50,000 times.

Phosphorus Slag as an Insecticide

THE slag or dross formed in the removal of phosphorus from iron ore has been for years used as a fertilizer, on account of the phosphorus that it contains, and also on account of the lime. Recent investigation has shown that the use of this slag is even more profitable than had at first been supposed.

The cultivation of the sugar beet in Germany suffers great damage from the plant louse. The depredations of these bugs are destructive to a large number of plants. All mixtures or liquors used for spraying plants as a protection against these insects have been applied in vain. The "false brown rust" or "curl" of the peach is caused by the plant lice, and it cannot be successfully fought because neither liquors nor powders can be made to reach the little animals. When the beet plant is attacked, the leaf curls up and protects the insect against any treatment the farmer may apply.

It has been found that by the application of large quantities of nitrates after rains, the beet is stimulated to push out new leaves, which take the place of those destroyed by the plant lice. But this method has its dangers since an excess of nitrogen in the soil may be just as harmful to the plants as the action of the insects. J. P. Wagner, a sugar beet expert, recently told the National Society of Agriculture in France of a successful attempt to fight these insects by means of phosphorus slag. He spread about 1,400 pounds of the phosphorus slag to the acre on fields that were infested with the plant louse. Not only did this treatment prevent the insects from attacking the leaves, but they were driven away from leaves they had already attacked. On another field the slag was applied in larger quantities. Every plant was already attacked by the insects when the dross was applied. Within eight days all the insects had disappeared, and the plants recovered their healthy appearance and color.

The method by which the phosphorus slag operated in these cases is not known. Wagner thinks that the compound forms a thin layer on the leaf, spreading out over the whole surface, and that it is either distasteful or injurious to the insect. It is well known that many lime compounds are injurious to animals with soft, naked skins such as snails, caterpillars, naked larvæ; but it has not been shown that a similar effect is actually produced in the treatment against plant lice with phosphorus slag.

The Foundering of a Japanese Submarine

A Remarkable Letter

ON April 16th last, submarine No. 6 of the Imperial Japanese navy was lost while manuvering in Hiroshima Bay and all on board perished. She was commanded by Lieut. Takuma Faotomu, and after the vessel was raised, a letter of farewell from him was found in her conning tower. This remarkable document will be read with interest. The translation from the original published in the Japanese press, appeared in the Kobe *Herald*, and is as follows:

"Although there is indeed no excuse to make for the sinking of his Imperial Majesty's boat, and for the doing away of subordinates through my heedlessness, all on board the boat have discharged their duties well and in everything acted calmly until death. Although we are departing in pursuance of our duty to the state the only regret we have is due to anxiety lest the men of the world misunderstand the matter, and that thereby a blow may be given to the future development of the submarines.

Gentlemen, we hope you will be increasingly diligent without misunderstanding the cause of the accident, and that you will devote your full strength to investigate everything, and so secure the future development of submarines. If this be done we shall have nothing to regret.

"While going through gasoline submarine exercise we submerged too far, and when we attempted to shut the sluice valve, the chain in the meantime gave way.

"Then we tried to close the sluice valve by hand, but it was then too late, the rear part being full of water, and the boat sank at an angle of about 25 degrees. The boat rested at an incline of about 12 degrees pointing toward the stern. The switchboard being under water the electric lights gave out. Offensive gas developed and respiration became difficult. About 10 A. M. on the 15th the boat sank, and under this offensive gas we endeavored to expel the water by hand pumps.

"At the same time the vessel was being submerged we expelled the water from the main tank. The light having gone out the gage cannot be seen, but we know the water has been expelled from the main tank.

"We cannot use the electric current entirely; the electric liquid is overflowing, but no salt water has entered and chlorine gas has not developed. We only rely upon the hand pump now. The above has been written under the light of the conning tower, when it was about 11:45 o'clock. We are now soaked by the water which has made its way in. Our clothes are pretty wet and we feel cold. I had always been used to warn my shipmates that their behavior (on an emergency) should be calm and delicate, while brave; otherwise we could not hope for development and progress, and that at the same time one should not cultivate excessive delicacy, lest work should be retarded. People may be tempted to ridicule this after this failure, but I am perfectly confidant that my previous words have not been mistaken. The depth gage of the conning tower indicates 52 feet, and despite the endeavor to expel the water, the pump stopped, and did not work after 12 o'clock. The depth in this neighborhood being 10 fathoms, the reading may be correct.

"The officers and men of submarines must be appointed from the most distinguished among the distinguished, or there will be annoyance in cases like this. Happily all the members of this crew have discharged their duties well, and I am satisfied. I have always expected death whenever I left my home, and therefore my will is already in the drawer at Karasaki. (This remark applies only to my private affairs, and it is not necessary. Messrs. Taguchi and Asami please inform my father of this).

"I respectfully request that none of the families left by my subordinates shall suffer. The only thing I am anxious about is this. * (Atmospheric pressure is increasing, and I feel as if my tympamum were breaking).

"12:30 o'clock, respiration is extraordinary difficult. I mean I am breathing gasoline. I am intoxicated with gasoline.

"It is 12:40 o'clock."

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Wright Machine in the National Museum

To the Editor of the SCIENTIFIC AMERICAN:

Referring to the suggestion in "Aeronautics" column of a recent issue of the SCIENTIFIC AMERICAN that a national museum should acquire an early Wright flying machine, it may interest you to know that the machine which the Wright brothers flew at Fort Myer (Washington) drill grounds, and which was bought by the Government, now hangs in the old building of the National Museum, having been placed there by the War Department.

Washington, D. C. C. FRANCIS JENKINS.

Taxing the Professional Man

To the Editor of the SCIENTIFIC AMERICAN:

Replying to your question in the number for May 4th, page 394, first column: "What State levies a tax on members of the bar, or, indeed, of any profession?" permit me to say that for eight years, previous to a few years ago, I carried on business as a professional photographer at Newport News, Va., and that I paid an annual license fee of $51.75 for this privilege; part of this fee being for the city and part for the State. It was my understanding then that most, if not all, the professions, including the bar, were thus required to pay a license fee. And this was a charge in addition to any tax on property, both real and personal, including sewing machines and Bowie knives.

I think that this license taxation obtains in other Southern States besides Virginia.

Haines Falls, N. Y. SAMUEL E. RUSK.

Oregon's Roads

To the Editor of the SCIENTIFIC AMERICAN:

In reading your Good Roads number of March 16th, I find on page 240 the statement that you were unable to secure any information from the State authorities. You also state that the total mileage is less than 30,000.

I will be pleased to furnish you any information you may wish in the future, but I wish to correct the figures quoted by you. Oregon had 34,258 miles of public highway in 1904, according to the United States Public Roads bulletins. My data are not quite complete, but a conservative estimate gives the State practically 40,000 miles to-day. About $3,000,000 was spent last year by the different counties and road districts.

Two sets of highway bills have been prepared for initiative action this year, both creating the office of State highway engineer. One gives him absolute authority and empowers the State to issue bonds, the other makes him an advisory officer and leaves the bond issues to the separate counties.

Corvallis, Ore. E. F. AYRES, Highway Engineer.

The Nut Problem Once More

[Those of our readers who have been following the correspondence on the problem originally published on page 174 (February 24th, 1912) will be interested in the letter reproduced below.—ED.]

To the Editor of the SCIENTIFIC AMERICAN:

I offer the following solution of the equation

$$A = 3\frac{53}{1024}F + 1\frac{452}{1024}$$

which seems to me to be more complete than the one you give in your Notes and Queries column, vol. cvi., No. 17, page 390:

$$A = 3F + 1 + \frac{53F + 452}{1024}.$$

To find what integral value of F will make the fractional part integral, let

$$\frac{53F + 452}{1024} = M \text{ (integral)}$$

$$53F + 452 = 1024M$$

$$F = \frac{1024M - 452}{53} = 19M - 8 + \frac{17M - 28}{53}$$

Repeating the process:

$$\frac{17M - 28}{53} = N \text{ (integral)}$$

$$17M - 28 = 53N$$

$$M = \frac{53N + 28}{17} = 3N + 1 + \frac{2N + 11}{17}$$

Again:

$$\frac{2N + 11}{17} = P \text{ (integral)}$$

$$2N + 11 = 17P$$

$$N = \frac{17P - 11}{2} = 8P - 5 + \frac{P - 1}{2}$$

From which it is obvious that $P = 1$ gives the smallest integral value for N and the other letters in order backward.

$P = 1$
$N = 3$
$M = 11$
$F = 204$
$A = 624 = 1/5$ (whole number of nuts) — 1.
Whole number of nuts = 3,121.

New Bedford, Mass. FREDERICK D. STETSON.

Is Oxygen a Drug?

To the Editor of the SCIENTIFIC AMERICAN:

I beg to refer to your editorial "'Doping' Athletes with Oxygen," in issue of April 6th. In the same you declare Sir Edwin's proposal, to feed the Marathon runner with oxygen as with soup and water, to be "amazingly unscientific." At the same time you make several citations, as "oxygen jag," in which "ideas swarm, but it is hard to seize them;" and several statements, such as "Oxygen is a 'drug' that 'dopes' the recipient, quite like many other drugs;" "pure oxygen is a stimulant," but "as with all stimulants, excessive and occasionless use is dangerous;" and you speak of "oxygen intoxication."

I would consider it in the interest of sound knowledge if you would kindly mention the authority you cite against Sir Edwin's statement, as well as the source of your information. Interested in the subject of oxygen as any man would be who takes good care of his life, and gathering my information from authorities which I believe to be leading, I beg to differ with your opinion. The question whether or in what degree the designations "stimulant," "dope," and "drug" are proper to be used for oxygen should be cleared.

To say that oxygen is a "stimulant" is very nearly correct, but more correct is to say that it is "the physiological stimulant." My authority on hand is Verworn, who in his "Allgemeine Physiologie" frequently mentions oxygen as "the only physiological stimulant and energy producer of living organism."

Among the "all stimulants" in which you seem to class oxygen, is there any one that is a physiological necessity, or one that forms a predominant physiological condition of life, as is the case with oxygen? If oxygen is a stimulant, we cannot do without it; all others are stimulants without which we do better. Similarly, I would ask if among the "drugs" that are "dopes," used to increase cardiac action, or in some way to artificially raise vitality, to exhilarate, if among these "doping" substances there is one which is a normal constituent of our system, or which normally circulates in our body fluids? I can think of none, except perhaps adrenaline.

My further contention is that oxygen in the case of a runner is not used as a stimulant, but as a corrective for "lack of oxygen" and "metabolic abnormalities," that such stimulant as you have reference to is not needed in the case of the runner, and that oxygen in the most natural way can only benefit and never endanger the exhausted individual.

The heart of a runner beats abnormally rapid, therefore the mechanical part of the work of the circulatory system is highly efficient and a cardiac stimulant is not required. The real danger for the runner are fatigue and exhaustion. These are due to the accumulation of fatigue products and to lack of oxygen. Fatigue products are dissimilatory products of incomplete combustion. Principally lactic acid is known to be produced by the work of muscles. Both lactic acid and lack of oxygen are reciprocal in cause and consequence, i. e., lack of oxygen, due to the extreme draught under which the respiratory process is placed, is the condition for the formation of products of incomplete combustion; and again, acid products (fatigue products, lactic acid) formed in the muscles and circulating through the blood, result in conditions averse to normal oxidation as well as to oxygen absorption; hence lack of oxygen. This is a pathologic condition which can be remedied to a great extent by increasing the *partial pressure of oxygen for respiration.* It should be remembered also that in the case of the short distance runner or of hard work, oxygen consumption increases to seven or eight times the normal. If our system had enough flexibility to correspond, feeding such increased demand steadily, and if the acid products circulating in the blood and in the tissues of the lungs would not interfere with adequate oxygen absorption, the organism might continue to be satisfied with a twenty per cent oxygen atmosphere. But experience has shown that such is not the case. Therefore, respiratory processes are greatly assisted by higher oxygen tension in the lungs, and this is accomplished by adding to the air which the panting runner breathes, pure oxygen, or enabling him to take a few breaths of oxygen unmixed. But this is not exactly stimulation, and should it be called so because it increases the vitality by combating fatigue, it is stimulation by just the substance which physiologically is wanted.

As a few authorities on the physiology of running, on fatigue products, and on pathology of lack of oxygen, I may mention Zuntz and Schumburg ("Physiologie des Marsches"), Loewy-Zuntz, Müller, Caspari ("Höhenklimer," etc.), Verworn, Mosso, S. Schrötter, Haldane and Smith, Martin H. Fischer.

Oxygen "intoxication" is a layman's expression, and seems to me misleading for the numerous readers of your scientifically recognized paper. In the above sense we can speak of a "waste products intoxication" and of an oxygen "disintoxication."

Moreover, the difference between the physiological stimulant and any other stimulant is besides that the first is normally and at a normal fixed rate absorbed by the blood and the latter abnormally and at a non-fixed rate. I cite Nagel's "Textbook on Physiology of Man," I. 1, p. 84; Christian Bohr, "Blutgase und Respiratorischer Gaswechsel": "With increased tension (of oxygen) the increased absorption follows at reduced rates, and before atmospheric oxygen tension (in the blood) is reached an increase of tension has but little influence upon the absorbed amount of oxygen; at saturation with pure oxygen under a pressure of 760 millimeters red blood corpuscles absorb proportionally insignificantly more oxygen than at saturation with atmospheric air." And the same, p. 216: "When breathing gas mixtures enriched with oxygen or pure oxygen under atmospheric pressure at not excessively long periods, oxygen absorption and carbon dioxide secretion do not show important deviation from the normal. However, respiration of pure oxygen under a pressure of three to four atmospheres or respiration of ordinary air under a pressure of fifteen to twenty atmospheres acts quickly deadly, as has been shown by P. Bert."

This of course is a condition which can only be produced in a laboratory by the necessary paraphernalia. But the above should bear evidence that the runner, who is under oxygen starvation on account of the pathologic "fatigue" condition of his blood, and even a normal individual, whose blood should be of normal oxygen capacity, runs no risk in breathing pure oxygen for a while, and that the word "intoxication" is physiologically out of place.

The immediate effects of oxygen inhalation are not felt by the reflectory nerves; in other words, produce no sensation. Any man who, in breathing oxygen at higher than aerial partial tension, feels exhilarated and like getting an "oxygen jag," is either subject to imagination or the gas contains some impurity that produces the effect.

The soup or any nutriment which the runner consumes during the run I would, rather than oxygen, consider a stimulant or a tonic. The effect which these produce is more in the nature of satisfying the secretive functions of the system than of supplying energy. The energy in such extreme strain depends on the body's stores. Water and oxygen are in my opinion the most needed factors in the maintenance of the energetic and respiratory functions of the system under extreme strain during a period of several hours. I am however puzzled by your reference to "nascent" oxygen. Has Sir Edwin really said so?

I would conclude that we may consider oxygen a stimulant or *the* physiologic stimulant, a nutriment, an energy producer, a life sustainer, a corrective of depleted metabolism, or in general term, an invigorator—it is all that by nature of the physiology of organized life; but we should not consider it a drug or a dope, an intoxicant or narcotic, nor a danger, if pure and not dry.

I would deem it a favor if you will give publicity to this very brief outline on the rôle of oxygen in the case of the runner.

New York city. RICHARD VON FOREGGER.

[Most controversy is over terms and definitions, rather than over ideas. Pure oxygen is a stimulant, in that it excites a diffused and transient increase of vitality and energy. Stimulants are oftentimes "indicated" in disease; but the use of any stimulant beyond the body's physiological needs is intoxication ("jag" in the vernacular). A drug is a medicament ("dope" in the vulgate); pure oxygen is such in anemic coma, lobar pneumonia, etc. Pure oxygen is not a physiological stimulant; but atmospheric air (oxygen 20 + parts with nitrogen 80— parts) is a most salutary physiological remedy. Hydrogen is not a physiological remedy; but hydrogen + oxygen (H_2O) is. Carbon (like H and O) is a constituent of the body; but it is not a physiological remedy. However, C, H, and O in combination (as soup, for example) make up a physiological remedy. Phosphorus, sulphur, iron, are essential constituents of the body, but not physiological remedies. The editorial writer would restate his main thesis: that the drugging of Marathon runners (the race is of some 26 miles) with pure oxygen would tend to physical disaster, sooner or later, for the man thus stimulated beyond his natural powers; and would be most unfair to those competitors who depend frankly upon their own natural capabilities, adjusted to natural environment, for the victory. Lankester is not responsible for the term "nascent oxygen;" the editorial writer used it in the sense of "uncombined oxygen."]

A New Use for Potatoes

Raising Potatoes in Germany for Industrial Purposes

By H. C. Price

WITHIN the last ten years a new industry has sprung up in Germany which has already become of large commercial importance, namely, the drying of potatoes for stock food. This is done in potato-drying factories that are rapidly increasing in all parts of the empire. How rapid this increase has been is shown by the fact that in 1907 there were but 118 such factories in Germany and last year there were 404 in operation, notwithstanding the fact that in that time the potato crop of Germany was the poorest they have had for many seasons and the price unusually high.

German Potato Crop.

Germany grows nearly five times as many bushels of potatoes as the United States. They produce on the average two and one half times as large an area and the yield is twice as much per acre. In fact, only two other crops, those of rye and oats, surpass the potato crop in acreage in Germany. In America potatoes are grown exclusively for human food, but not so in Germany; immense quantities are grown for industrial purposes and used for manufacturing starch and denatured alcohol and for drying, all of which are important industries. The market quotations are given regularly for potatoes for eating purposes and potatoes for manufacturing purposes and the price of the latter, as a rule, is about two thirds that of the former.

Much attention is given to breeding potatoes for starch content and experiment stations are maintained in the various provinces to test the different varieties for yield of potatoes, yield of starch per acre, as well as per cent of starch content. The test this past season of one hundred and twenty-five varieties, showed a variation in the per cent of starch content in the different varieties grown under the same conditions of from 12 per cent to 25 per cent.

The Germans have paid particular attention to developing the starch content of the potato in order to increase its value for manufacturing purposes and in doing so frequently lose in size of tubers and yield per acre.

Development of the Drying.

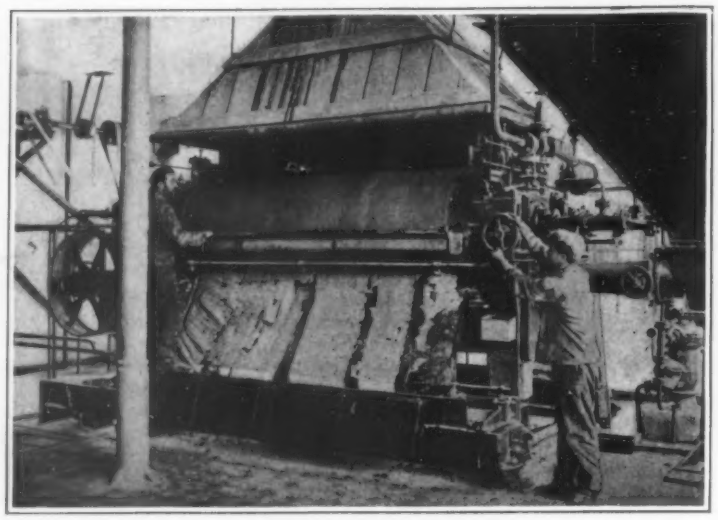
The development of the potato-drying industry has been the result of over-production and low prices. With such large areas grown, as is the case in Germany, in years of good crops there is a large overproduction. In such years formerly the farmers were obliged to accept ruinously low prices for their crops and were at the mercy of the potato merchants. The potato being perishable, it cannot be carried over from one year to the next as is the case with grains. It is easily frozen and when once frozen is ruined, so that the disposition of a surplus in a good crop year was a serious problem.

For some years the Germans had been drying the sugar beet pulp from the sugar factories (after the sugar had been extracted) and using it as stock food. This gave rise to the suggestion of using the surplus potatoes in the same way. This would not only utilize the surplus but would preserve it in a form in which it could be held indefinitely and stored without danger of freezing. It would also take the surplus off the market and insure a reasonable price for the rest of the crop.

The government and the agricultural organizations offered large prizes in the latter part of the nineties for the most successful methods of preserving potatoes, both for human and stock food. As a result a large number of methods and kinds of apparatus were offered, so that it can be said by 1900 entirely successful methods had been perfected.

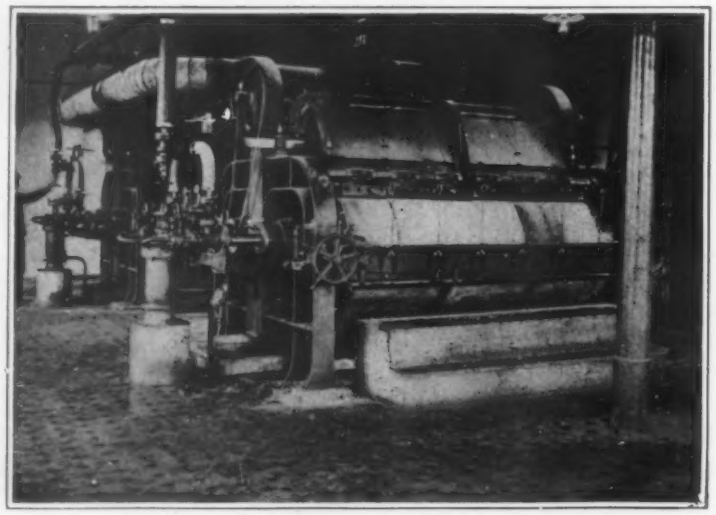
Two Methods Used.

There are two types of drying apparatus on the market. The one produces the so-called potato "schnitzel,"



Apparatus for manufacturing flocken.

A potato-drying factory in Germany.



One type of potato-drying machinery.

which is made by shredding the raw potato into pieces about as thick as a small lead pencil and drying it under very intense heat. The other produces what is known as potato "flocken" flakes. In this latter method the potatoes are first cooked by steaming and then mashed and dried by passing between hot rollers by steam. Since the rollers are placed near to one another, the mass passes between like a sheet of paper. The heat causes them to adhere to the exterior walls of the rollers and the motion is so regulated that they are completely dried before the rollers have half completed the revolution. Two knives on the outside of the rollers cut off the dried mass, which has a bright yellowish-white appearance, a good smell, and forms a coarse sort of potato meal.

In the drying of the raw potatoes, the shredded pieces are first exposed to very great temperatures, often as high as 1,000 deg. Cent. (1,832. deg. Fahr.), as they are carried slowly through a long chamber with the temperature constantly decreasing. When they go into the drying chamber as raw potatoes they contain 75 to 80 per cent water, and when they come out as the dried product or "schnitzel" they contain 12 to 15 per cent water. In the manufacture of the flocken such high temperatures are not necessary, as the potatoes are first cooked, but when finished they contain approximately the same amount of water as the schnitzel.

The amount of raw potatoes required to produce one hundred pounds of the dried potatoes, depends upon the starch content and dry substance in the potatoes used, as well as upon the amount of moisture contained in the finished product. The following table shows the amount of dried potatoes, either as schnitzel or flocken, containing 15 per cent moisture that can be produced from potatoes of different qualities:

Amount of Raw Potatoes Required to Produce 100 Pounds of Dried Potatoes, Containing 15 Per Cent Moisture, and When They Contain

Per Cent.		Per Cent.		Lbs.
12	starch	17.8	dry matter	480
14	"	19.8	" "	460
16	"	21.8	" "	390
18	"	23.8	" "	360
20	"	25.8	" "	330
22	"	27.8	" "	310
24	"	29.8	" "	290

Use of the Dried Potatoes.

The dried potatoes, both schnitzel and flocken, are used as food for horses, cattle, sheep and swine, and have come to be an important product on the market and are regularly quoted in all market reports. The potato flocken is preferred, as it is more digestible, and of the 404 factories in operation last year, 314 were equipped to manufacture flocken. That may be due in part to the fact that it does not cost as much to install an apparatus to manufacture potato flocken as it does to manufacture schnitzel. On the other hand, after the equipment has been installed, the potato schnitzel can be manufactured more cheaply than the flocken. The Germans count that it costs $1 to $1.50 per ton of fresh potatoes to dry them in the form of schnitzel and $2 to $2.50 per ton to dry them in the form of flocken.

Although dried potatoes may be used for all classes of livestock, as a matter of fact, they are used principally at the present time for swine. Experiments and practical experience have proven that dried potatoes may be used almost entirely to replace corn in the ration, and this is of decided advantage to Germany, since all the corn that is used has to be imported.

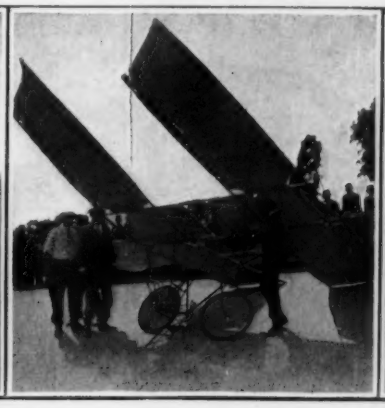
Advantages of the System.

The extent to which potatoes are dried from year to year for stock food depends upon the crop. In years of over-production the surplus is dried and thus put into a form that can be preserved for an indefinite length of time. By drying the surplus the farmers are saved from ruinously low prices for their crops. In years of short crops, such as last year, it is used principally to utilize the culls and potatoes that are not suitable for human food. The dried potatoes are not only in a form that can be stored without danger of frost and for any length of time, but the weight is reduced about three-fourths, so that the cost of transportation is reduced in like proportion, and surplus in one section can be shipped to other sections of the country without great expense.

The system has passed the experimental stage and has taken a permanent place in the agricultural manufacturing industries of Germany.

The Failures of the "Aviettes"

Impossible Performances for an Impossible Prize



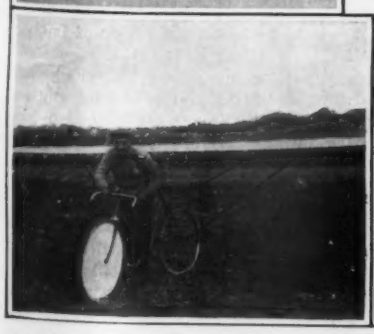
PERHAPS it was merely a desire for publicity, perhaps an exuberant sense of humor, that prompted Peugeot Frères to offer two prizes for flights made with the aid of human muscular energy alone. Surely at this late day no one, and least of all a firm of bicycle manufacturers, can plead gross ignorance of the first principles of cycling and of aviation, by offering a first prize of 10,000 francs for a machine which, propelled by human power alone, would cover a distance of 10 meters (32.8 feet) twice in opposite directions, and a second prize of 1,000 francs for a machine which would cover a distance of 1 meter (3.28 feet) at a height of 10 centimeters (about four inches).

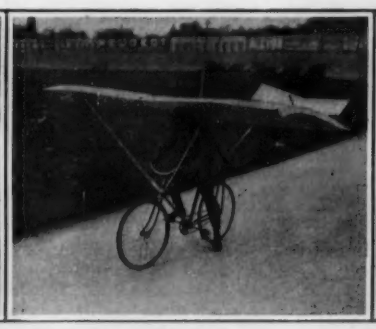
Although neither prize could possibly be won (the machines had to run on level ground, and having covered the prescribed distance, were to turn immediately and fly back to the starting point), Paris evinced an extraordinary interest in this *Concours de l'Aviette*. No less than one hundred and ninety-eight entries were received; but only twenty-three covetous aspirants to aviation fame appeared on the scene at the appointed hour. In the expectation of seeing a very novel contest, no less than two thousand five hundred people witnessed the futile attempts of most of the twenty-three to enrich themselves at the expense of Peugeot Frères. There was much hooting, much whistling, much jeering, and much mock encouragement.

The ignorance displayed by many of the designers of the machines entered is simply amazing. Even elementary principles were ignored. Almost every one of the machines that appeared at the Parc des Princes on June 2nd could not possibly get up a speed of more than fifteen miles an hour, so heavy were they. Wings had been mounted on bicycles, apparently with no conception of the relation of lifting effect to speed and area of supporting surface. Some of the machines were provided with elevating and vertical rudders; some had no guiding device of any kind; some were fitted with propellers, and some had no propellers at all. Apparently none of the men who entered realized that a regular motor-driven flying machine must have a speed of at least twenty-five miles an hour before it can vault into the air. Twenty-five miles an hour on a bicycle is a remarkably creditable performance. Riders who have made it know how considerable is the wind resistance encountered even at that rather moderate speed. The dramatic performances of men who have ridden behind railway trains (intended primarily to minimize air resistance) have evidently been without effect upon the general reading public. If a bicycle rider finds it difficult to travel at high speed on the open road, how is it possible for a man on an "aviette" to acquire a preliminary speed great enough for him to launch himself into the air, when at either side of the machine wings are to be found that have an area of forty square feet and that offer an enormous head-on resistance?

Obviously impossible as it was to rise from the ground even with a monoplane aviette, some of the contestants were foolish enough to attempt the feat with biplanes. An inventor named Piat, of Boulogne, for example, entered a biplane designed somewhat on the principle of a Farman machine. Another, from Montrouge, named Vincent, made attempt after attempt to win the 1,000-franc prize with a batlike machine fitted with double wings. Throughout the day he made effort after effort to get into the air. Again and again his friends started him off toward the track. The manner in which his performances were received by the crowd may be conjectured.

Although no one succeeded in leaving the ground, consolation silver medals were awarded to the sixteen men who trundled out their machines and had the courage of their convictions. The contest was supervised by a *Commission de l'Aviette*, consisting of Jacques Balsan, de Knyff, Etienne Giraud, Isaac Koechlin, Rodolphe Koechlin, Tissandier, Paul Rousseau, Frantz Reichel and Alibert. The prize offer remains open until the spring of 1913. It is said that another contest will take place some time in the month of October.





A French firm of bicycle makers offered a prize of ten thousand francs (two thousand dollars) for a flight of ten meters (32.8 feet) made with human muscular energy alone. One hundred and ninety-six machines were entered, of which twenty-three were actually constructed. Not one of the machines was able to get off the ground.

Club moss (*Selaginella*).

Horse-tail or scouring rush (*Equisetum*).

Common sweet pea.

A tip of one of the Indian hemps with fibrous bark and milky juice (*Apocynum*).

These specimens are inlaid on cardboard, the brilliancy of natural colors fully preserved and the mounting as smooth as a water color painting.

Preserving and Mounting Plant Specimens

How Pressure and Heat Can be Effectively Used

By Clara Reese

A SIMPLE and effective method of preserving plant specimens has been discovered. The process is likely to revolutionize the present slow and laborious preparing and mounting of herbarium collections. As a matter of scientific experiment the botanical department of the University of Pittsburgh, Pa., is giving the new process a trial.

The plant specimens to be mounted are brought in fresh and moist from garden or conservatory. These are subjected to a forced process of drying which preserves the natural colors of stem, leaf and flower. After this they are imbedded, or inlaid, on a yielding surface such as blotting paper, cardboard, silk, woolen or rubberized material, and when finished present the smoothness and evenness of a painting.

In demonstrating the process for me the inventor broke a leaf from a primrose plant in the presence of the writer. This leaf was laid smoothly on an ordinary piece of blotting paper. The blotting paper in turn was laid on a small steel plate neither much larger nor much thicker than a 5x7 camera negative. Several sheets of blotting paper were piled upon the primrose leaf to absorb the moisture and the whole laid upon the bed plate of an ordinary toggle press of hand leverage. A few steel plates were thrust in upon the blotters in order to build up the material to a thickness to meet the requirements of the press. Before applying the leverage, heat was introduced into the bed plate by means of a small pipe and a stopcock. The lever was forced down by hand, and at the expiration of thirty-five seconds, a cold draught succeeded the hot one in the bed plate, and the dried specimen was removed. It showed its original freshness, while the heat bath it received, somewhere about a temperature of 200 deg. Fahr., effectually destroyed all germ or insect life.

By immersing the card in cold water for an instant, the dried leaf slipped easily from the card. It was then laid upon the sheet to which it was to be permanently mounted or inlaid. Practically the same process in the toggle press for the permanent mounting was gone through with, though "arms" were adjusted to the lever in order to give a higher degree of pressure and less heat was turned on in the bed plate. The inventor gives the completed specimens a final wash of liquid celluloid and alcohol as a protection to the same in case of rough handling.

The discoverer of the process is William Heeren, who has spent most of his lifetime as a skilled artificer in precious metals. Mr. Heeren appeared before the Botanical Society of Western Pennsylvania at a recent meeting and exhibited many of his imbedded specimens. As yet he has not succeeded in the inlaying of the natural plant in a ground of silver or gold, but he claims perfection so far as a yielding surface is concerned. He has hundreds of specimens and has subjected these to severe tests to prove the preserved colors as lasting and the inlaid growth as practically indestructible.

Mr. Heeren has kept his finished specimens under water for a week at a time and has lifted out the cards with their inlaid growth still unimpaired. He has imbedded his leaves and flowers in celluloid or transparent ground and hung them for months in the window in the sunlight as "transparencies." He has used his mountings as decorative lamp shades and as shades for electric bulbs and after a heated test of six months or more of household and office routine use, the roses, pansies, violets and ferns are as bright as ever in their first color. Others are hung where they are subjected to atmospheric changes.

This experimenter is equally successful in imbedding specimens whether of thick-stemmed and woody variety or of the most delicate and feathery of plant growth. He has inlaid clumps of moss and corsage bouquets of violets, and he has inlaid the delicate tracery of asparagus vine and the dainty petal of a rose. He has inlaid heads of grain, princess feathers and specimens of cattail, and he has likewise inlaid the ethereal quaker lady, the sweet pea and wood violet. There has really been no limitation in his experimentation, and sprays from bridal bouquets find themselves imbedded in small pieces of celluloid as ready for mounting as brooches and buckles.

A floral belt has a place in his experiment collection. In this instance the moss rose buds have been imbedded in a durable yielding strip of material. As the strip came from the hydraulic pressure, a corded ribbon of rich quality was laid over the strip and the whole put through a roller. The ribbon was then peeled off and the belt strip appears with its silken and corded markings. Many dainty "trimmings" of shear material and silken fabric have their inlaying of delicate flower or vining. Mr. Heeren has not confined his experiments exclusively to plant growth, but butterflies and brilliant-hued insects are imbedded in a lasting manner. A most perfect and rich specimen of a peacock's feather is inlaid on a black rubber panel.

Mr. Heeren is not a botanist and will likely develop his discovery along ornamental lines as suitable to his craftmanship. His workshop shows the ornamental trend in the grouping of blossoms and colors and ideas for fans, handbags, girdles, gift cards, brooches and buckles, likewise lamp shades and transparencies. The possibilities in these lines are endless.

Nevertheless, Mr. Heeren is making a herbarium by the usual process and is mounting specimens of plant growth the old way as a comparison with the new method. By the old plan the specimens are carefully arranged on bibulous paper, and pressed between smooth boards by putting weights or using a screw press. The paper is changed every day or two as the plants part with their moisture. When the process of desiccation is complete the specimens are fastened on sheets of paper by gummed strips. To protect these dried brown specimens from the ravages of insects, camphor is renewed frequently in the cabinets.

In his demonstration before the Botanical Society, Mr. Heeren contrasted the two methods and showed how the new way in the hands of botanical experts might bring a practical herbarium within reach of the ordinary class room without danger of mounted dried specimens breaking loose from cards or of destruction by insects. The "wash" given the inlaid cards preserves the specimens from inroads of insects. He showed how science might utilize the method likewise in a systematic arrangement for a large herbarium.

Mr. Heeren showed also how outlines might be printed for the youthful botanist to properly color. He deftly lifted an inlaid specimen out of its tight bed and showed how the matrix or impression might be used for printing an outline on drawing paper. He has examples of this outline printing as accurately defined as an engraving. In the hands of the skilled botanist, the inventor says, there is no reason why plant and flower should not be preserved in natural color and desired arrangement with much less waste of time, labor and space, than at present.

Mr. Heeren's discovery is the further development of an idea of his which is now classed as a successful invention, namely, the celluloid tags or number plates seen everywhere on the caps or coats of expressmen, messengers, porters and others in uniformed service. As the numbers are separate with each individual, these numbers are necessarily inlaid by a quick process. These smooth white disks with their black numerals are turned out in great quantities in a special factory under the supervision of the inventor. The curved plates for the caps are shaped on a curved bed plate in the toggle press. On a recent round the world trip, the inventor met his tags in every land and introduced himself in Alexandria, Egypt, by removing one from the cap of a porter and pointing to the firm name and address on the under side.

The Practical Use of Seaweed

SIX kinds of seaweed are used in the construction of Japanese isinglass, or agar-agar, the method of manufacture being described as follows in a recent U. S. Consular report: The seaweed is first crushed, each kind separately, to remove shells or other adhering matter, and then washed clean with water. The washed seaweed is placed on a mat and dried until its color becomes white by the action of the sun, frost, and dew. This operation takes place during September and October, and when bleached the weight of the seaweed is decreased nearly one-half. After bleaching, the six kinds of seaweed—in the proportion of Izu, 4; Egokusa, 4; Misaki, 3; Hirakusa, 3; Nanbu, 4; and Onikusa, 2—are all put together in a boiler and cooked for about 14 hours, until they have become soluble. The liquid is then strained through a sack and a box with a bamboo sieve on one side, from which it runs into a container. From the container the liquid is ladled into trays about 3½ feet long and 3 inches deep. After remaining in the trays about 12 hours these are placed on a low stand, and the isinglass is cut into strips 3 inches wide and 14 inches long, with a knife and ruler. These strips are then put into a long closed wooden box (the ends of which are 3 inches square, one end being open and one filled in with a wire sieve) and pushed through the sieve end in the form of long fine strips. The isinglass is then placed on a low stand, which is covered with a clean mat, and dried in the sun during the day and frozen during the night for two or three weeks during January and February, being watered at midnight.

The Laboratory

Some Suggestions for Home Experiment

Experiments With High-frequency Currents

By Philip Edelman

THERE is perhaps no one piece of apparatus so interesting as a high-frequency or Tesla coil. With it the laws of electricity are apparently violated. Thousands of volts are taken into the body with no unpleasant effects, lamps are lighted without connecting

Fig. 1.—The completed coil.

wires, insulators become conductors, and various other wonders are accomplished. There is no end to its wonders, and yet it is a comparatively simple piece of apparatus.

There are two general types of these coils, the oil-immersed and the open-air kind. For performing the following experiments the latter type will be described, as it is much simpler and accomplishes the same results.

The secondary of the coil is wound upon a paper or fiber tube 10½ inches in diameter and 10½ inches high. Beginning ½ inch from one end, wind 80 turns of No. 28 spring brass wire upon this tube. Wind this wire on very carefully, spacing each turn 3/32 of an inch apart. About 1/3 pound of wire will be needed. Give the finished secondary several coats of orange shellac, allowing each coat to dry before applying the next. The ends of the wire are fastened to the tube by punching two holes in it and sewing the wire into them.

For the primary winding, form 7½ feet of No. 4 rubber or weatherproof covered wire into two turns 13 inches in diameter and as near to a perfect circle as possible. The complete coil is shown in the photograph, Fig. 1.

The accessory apparatus necessary are: a ¼, ½, or 1 kilowatt transformer or large spark coil; a large condenser, gap, etc. The transmitter of a wireless station will just about conform to these requirements. This Tesla coil will work to some extent even on a 1-inch spark coil. It gives a 3 to 5-inch spark on ½ kilowatt, according to the adjustment.

Two methods of connecting the coils are shown in Fig. 2, an alternative form being given in Fig. 3. The success of the coil depends on the adjustment. You must have the right amount of capacity (condenser) and the right length of spark gage or you will get but poor results. You can only determine this by trial. After you have found the right proportions and the coil is sparking well, you are ready for the experiments.

Ground the lower terminal of the coil and close the switch controlling the spark coil or transformer. Now bring your hand near the top of the coil. These experiments are best done in the dark. Before you bring your hand near the coil, the top of the secondary glows with a beautiful corona brush. I have seen this done with a 15-kilowatt outfit. Snake-like twisting sparks shot out from the top. You may be able to see these on a small scale. As your hand approaches, a beautiful blue brush forms between it and the coil. The color intensifies until—"Ouch!" A spark jumps to your hand and stings you. Now hold a pair of pliers, screwdriver or any metal piece in your hand and repeat the

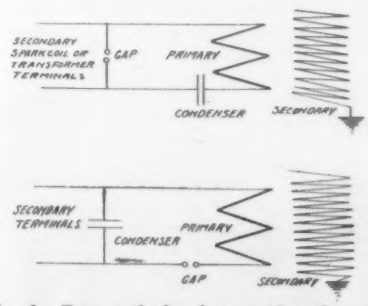


Fig. 2.—Two methods of connecting the coil.

experiment. This time the spark jumps to the metal and then into your body. If you are using less than ¼ kilowatt in the coil you will not feel any pain; ½ kilowatt will sting a little.

You may wonder at this. You know that if this had been an ordinary spark at low frequency it would have been a terrible jolt, if nothing worse. Roughly counting 15,000 volts to the inch, you can readily calculate what you have just had through your body. But high-frequency currents, unlike low-frequency currents, travel on the outside of a conductor, and do not penetrate the inside. The current travels on the outside of your body, and does not penetrate to your nerves. The sting you felt was caused by the heat.

After you have become accustomed to taking this spark, grasp an incandescent light bulb in your hand, as shown in Fig. 3, and bring it to the top of the coil. Sometimes in doing this the filament is jerked to pieces. An 8 candle-power lamp works best. The filament lights up. Try the lamp on the middle and also near the bottom of the coil. The lamp lights up brighter near the bottom than on top. There are numer-

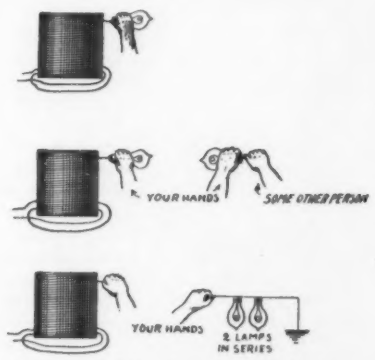


Fig. 3.—Lighting lamps without wires.

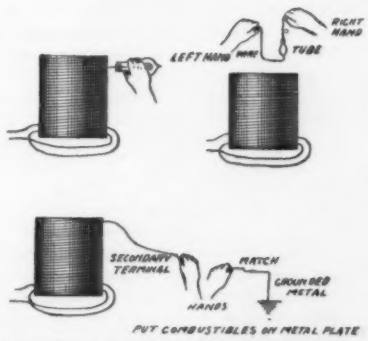


Fig. 4.—Experiments with burnt-out bulbs and lighting a match.

ous variations to this experiment. For instance, two lights can be lighted, as shown in Fig. 3.

Now grasp a lamp by the bulb (it may be a burnt-out lamp) and allow the spark to jump to the capped end of the bulb. Little webs of sparks will form and the filament will dance around. The filament may get red hot. The bulb is now charged and if you put your other hand on the cap you will get a good shock. The bulb may be discharged to some one else, the ground or any conductive body.

Holding a burnt-out bulb by the cap, bring it near to the coil. At first it lights up a pearl green. Next bring it very close for a second, allowing the spark to puncture the glass, when it will turn a pink color, and then of you continue a while longer it will turn a purple color. While it retains this purple color it is quite sensitive, and lights up if held in the hand a few feet away from the coil. These effects vary with every bulb used. Sometimes exceptional effects can be seen, while at other times nothing extraordinary happens.

Geissler tubes held several feet away from the coil light up brilliantly. They are real wireless lights because there are no connecting wires. You can trace the lines of force to a slight extent by changing the direction and position of the tube and noticing the change in the brightness of the tube. A strange effect is shown by Fig. 4. Your hand and the tube form another secondary of the coil. Besides the tube's lighting, little sparks pass from the hand to the tube. If you vibrate the tube backward and forward rapidly, you can see little bands of light and shade.

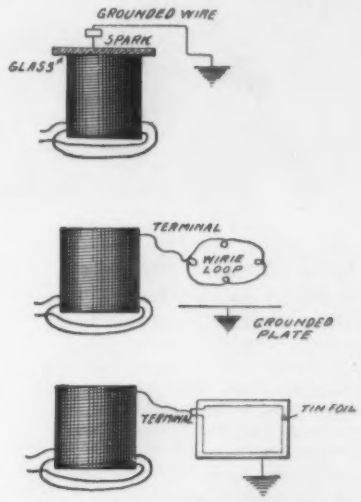


Fig. 5.—Curious brush discharges and illuminated signs.

You remember the burning sensation of your first spark. To prove that this spark is very hot, you can light a match by it. It is best to use a pair of pliers for comfort. You can burn wood, paper, light a candle and powder in this same way. Try the experiment with these materials, as shown in Fig. 4.

If a glass plate is laid on the coil as in Fig. 5, the spark will seem to pass right through it. But the glass is not pierced; instead the spark is transferred to the other side of the glass by condenser action.

By forming loops of various shapes, as in Fig. 5, you can get some very pretty brush discharges from your coil. A name sign, Fig. 5, is prepared by coating one side of a glass plate with tinfoil and the other side with the name, formed with fine wire. A terminal of each side of the coil is connected to the plate and the name respectively.

Some Experiments With Blue Glass

By Prof. Gustave Michaud, Costa Rica State College

COMMON blue glass owes its color to the presence of cobalt. It is transparent for the two extreme regions of the spectrum, red on one side, blue and violet on the other. It stops most of the central spectrum, i. e., orange, yellow and green. From that point of view especially, it is altogether different from the yellow and red glasses used in photography and for which the absorption spectrum is unilateral. That the cobalt glass allows the free passing of the extreme red is by no means evident at first sight, and it seems as if only pure blue light were admitted. In the extremely simple experiment described here the red light admitted with the blue and violet is caused to stand away from both and thus becomes visible. This experiment is probably the only one in which an absorption spectrum can be distinctly perceived without prism, diffraction grating or apparatus of any kind.

(Concluded on page 18.)

The eye used as a spectroscope.

Inventions New and Interesting

Simple Patent Law; Patent Office News; What Inventors Are Doing

A new gun for use on aeroplanes.

The Lewis Gun for Aeroplanes

By William Joseph Wheatley

WHEN an aeroplane soared aloft from the Army Aviation School at College Park, Md., the first part of June, carrying a new rapid-fire gun, the invention of Lieutenant-Colonel Isaac N. Lewis, of the United States Army Coast Artillery Corps, these machines left the realm of air scouts and from that time forward became active engines of war for both offensive and defensive work. The possibilities of the new gun were realized when the aeroplane came down after Capt. Charles deForest Chandler, commandant of the school, who manned the gun on its air trip, had discharged a full magazine of fifty cartridges; and an examination of the target had disclosed the fact that the forty-five shots fired had buried themselves in a space three yards by eighteen. The white target of cheesecloth measured three yards by fifteen, and while a number of shots had pierced the cheesecloth, the greater part were bunched just off the end. Five of the shots from the magazine had been sent into a fishpond on the reservation in order that Capt. Chandler could get, by the splash of the water, an instantaneous report of the accuracy of his aim.

The aeroplane, driven by Lieutenant Thomas DeW. Milling, one of the army aviators, was humming through the air at approximately fifty miles an hour, and at an altitude of 600 feet, when a ripping sound heard above the roar of the engine told that the gun was in action. Twice again the aviators flew over the target until the magazine had been exhausted. The fact that this was the first time the gun had been taken aloft together with the trueness of the aim as shown by the examination of the target spoke emphatically then and there of the great possibilities of fleets of aeroplanes loaded with these rapid-fire guns, soaring over a column of the enemy's troops.

No smoke, no flame—only the sound of the explosion tells that the gun has been fired. There is no recoil and the gun is so balanced by the magazine that the aim is not even interrupted while the gun is being fired. It can be fired at as high a rate as 750 shots a minute, but the rate may be reduced to 350 shots per minute, or to any number between these limits, by a simple adjustment of the gas-port valve controlling the admission of the gas to the piston cylinder.

The principal and most novel feature of the gun is its air-cooling system. The 30-caliber gun barrel is surrounded by a close-fitting aluminium jacket, cylindrical in form and having some twenty deeply-cut longitudinal grooves which extend from breech to muzzle. The gun barrel with its grooved jacket is inclosed in a light steel tube 3¾ inches in diameter, the portion of the tube which projects beyond the muzzle having a reduced diameter of only 2⅞ inches. The inclosed grooves, forming continuous air ducts in the aluminium jacket throughout its length, have free communication with the atmosphere at the breech and each time the gun is fired the ejector action of the discharge blast sucks in a draft of cool air from the rear through these ducts, thus carrying off the heat transmitted to the jacket from the barrel. The cooling is automatic in action, without the use of water or other cooling liquid and without mechanism or moving parts. As aluminium has six times the heat conductivity of steel and but one-third its weight, this very effective method of cooling the gun adds but a few pounds to the total weight carried. Another novel feature which differentiates the Lewis gun from all other gas-operated guns is the small inclosed operating spring which is located near the trigger-piece at the breech far removed from all injurious heat effects. The temper of this spring cannot be affected by either direct or transmitted heat no matter how rapid and long-continued the firing.

When firing at full speed it takes approximately four seconds to discharge a magazine of fifty cartridges, and the empty magazine may be replaced by a full one within two seconds. The drum magazine used with this gun is 8¼ inches in diameter and 1½ inches deep. It is stamped from sheet steel, has an aluminium center piece to hold the cartridges in place, and resembles, somewhat, a reel used for winding cinematograph films.

Colonel Lewis designed the gun primarily for infantry and cavalry use, but its flameless feature coupled with the absence of recoil and its light weight brought to mind the possibilities of the rifle for aeroplane use, and a test was decided upon with the success already noted.

The development tests of the gun, which have been in progress for the past two years, show that the barrel does not become overheated under continuous fire at full speed, and that it will not therefore be necessary to carry along an extra barrel when on the firing line. Since no cooling water is necessary, and no special mount except a small stake or "cow-boy" mount weighing about eight pounds, the field equipment of the Lewis gun is reduced to a minimum. The gun may be fired from any natural support found in the field such as a rock, log, stump, tree or mound of earth. It is even possible to empty a magazine while holding the gun to the shoulder or from the hip, as the recoil effect is very slight.

It is a matter of note that one of the most conspicuous things on the battlefield in South Africa was the jet of steam from the boiling water which was being used on the barrels of the rapid-fire guns for cooling purposes.

Weighing as it does a little more than twenty-five pounds and requiring but one man to operate it, Colonel Lewis' invention has certainly made a great stride toward developing the aeroplane into a first-class ship of war.

The gun is simplicity in itself. It has only forty-seven parts, as compared with twice that number for other rapid-fire guns. On the battlefield or in the air where tools are necessarily scarce, and where they are needed more than anywhere else when they are wanted, Colonel Lewis' invention would certainly cause no worry, should some piece of the mechanism be broken or otherwise get out of working order, since the only tool required to disassemble or assemble the gun is the point of a bullet.

The sustained rapidity of fire of which the gun is capable makes it a far more dangerous and effective weapon than any bomb-dropping device as yet devised.

As soon as a new machine is delivered to the Signal Corps to replace the flier which was wrecked recently, further and more complete firing tests of the Lewis gun will take place at College Park. It is proposed to carry the gun and one thousand rounds of service ammunition to heights of 1,000 feet or more and fire at selected targets to determine the accuracy of fire at different heights and speeds. The results of these firings will no doubt have far-reaching effect upon navy and coast defense plans for the future. However, with the results already obtained in view, it seems only a question of Congressional appropriation to decide whether or not we are to keep the lead in aeroplane armament.

Another question brought up in connection with the possibilities of this gun is its ability to attack the men on the decks and in the fighting tops of battleships. Battleships of the future, of course, will be equipped with hydro-aeroplanes for scouting purposes and even, possibly, to report the gun ranges of the enemy. Should these hydro-aeroplanes each be equipped with the Lewis rapid-fire gun they would play havoc with the range-finders telephones, lines of communication and the personnel in the fire-control masts such as those with which the battleships of the United States are equipped. It would mean that the men who direct the fire of their guns from these fighting tops will have to be protected. Some form of overhead protection will undoubtedly be necessary to protect the fire-control personnel, and naval officers of the various bureaus are, it is said, much exercised over the possible effects of attempting such protection.

The gun made a very successful demonstration of its possibilities as a service weapon for the mobile army at Fort Myer, Va., recently, before Secretary of War Stimson, Major-General Leonard Wood, Chief of the General Staff Corps; Brigadier-General William Crozier, Chief of the Army Bureau of Ordnance; Brigadier-General Erasmus M. Weaver, Chief of the Coast Artillery Corps; Brigadier-General E. A. Garlington, Inspector-General, and Brigadier-General E. H. Crowder, Judge-Advocate-General.

The men who tried the gun.

The gun in use from the ground.

A $10,000 Prize for a Practical Sugar Beet Puller and Topper

THE Great Western Sugar Company of Denver, Colo., has offered a prize of $10,000 for a practical sugar beet puller and topper which shall fill the specifications given in a circular published by the company and which may be obtained free of charge on application to the company. From this circular we glean the more salient conditions as follows:

The beet puller and topper must fulfill the required specifications to the complete satisfaction of a committee of judges appointed by the company.

The offer may be in force until the first day of March, 1915, but the prize may be

awarded at any time prior to the first of March, 1915, when a practical beet puller and topper is forthcoming.

If two or more contestants fulfill all the required conditions and specifications, the committee of judges are to exercise their sole discretion and are to award the prize to the one who in their opinion has solved the problem most practically.

The contestants will be required to demonstrate their machines at such times and places as the committee of judges may designate. The contest is open to the general public including the employees of Great Western Sugar Company, and of all sugar companies.

The Great Western Sugar Company by awarding the prize will acquire no interest in the invention, design or machine of the successful contestant,

The motive power required for different soil and weather conditions must not be excessive, that is, it must not exceed four horses per beet row, if animal power is used. The device must pull and top all the beets and separate beets and tops, and leave the beets and tops convenient to load. It is especially understood that the work may be done by two machines, of which one does the topping, the other one the pulling or *vice versa*, although a combined machine is preferred. The pulling and topping must be done in a satisfactory manner. The beet puller and topper must be adjustable for rows spaced from sixteen to twenty inches apart. Damage to the beets or tops must be avoided as much as possible.

The selling price of the machine to the public by the local dealer, whether combined or otherwise, must not exceed $300 if the motive power is animal power and must not exceed $500 if belt-propelled.

Argental—A New White Metal

A Competitor of Silver.

A METAL or alloy, of very high-class qualities, has recently been evolved, after many years of research and experiments, by William A. McAdams. This new metal will be named "argental," because it is an alloy of silver and aluminium, the affinity of which is produced by chemicals and rare minerals, and it is par excellence as a substitute for silver having all its qualities except weight.

Argental has been produced to compete with silver, and for general manufacturing and industrial uses it is in many ways far superior to silver for the reason that, being alloyed with aluminium and cast by means of a patented compound and molds, or dies, it has many times greater strength than either silver or aluminum. It is white like silver and not leaden or blue like aluminium.

The silver in its composition prevents the aluminium from being attacked by ordinary alkalies, and the aluminium prevents the silver from being attacked by ordinary acids. The alloy cannot be affected by nitric acid, and it will not tarnish or oxidize, by exposure to the atmosphere or gases. Its specific gravity is only one third that of silver, and consequently three or four times the quantity of manufactured articles can be produced from the same weight as that of silver, such as watch cases and movements, forks, spoons, bells, tableware, ornaments, hardware specialties, typewriters and similar machines, not mentioning a number of other incidental articles.

Comparing argental in weight with other metals, we find that it is one fourth the weight of copper, one fifth that of iron, one-fourth that of gold, and one sixth that of platinum.

The alloy can be cast, die-cast, rolled, spun, drawn into wire, milled, engine-turned, and turned in the best manner and the finest of threads cut on it. It takes a fine polish.

This metal is simply pure silver, alloyed with aluminium by means of chemicals and rare minerals. In the case of argental, the silver is alloyed with aluminium, in order to produce a neutral metal, which is proof against ordinary acids and alkalies, and also to gain great strength and lightness.

Notes for Inventors

A Bread Wrapping Machine.—In a recent issue of the SCIENTIFIC AMERICAN we stated that a machine was needed for wrapping bread in suitable paper. We are in receipt of a letter from the *National Baker*, of Philadelphia, informing us that such machines are well known.

A Packard Automobile Invention.—The Packard Motor Car Company as assignee of Russell Huff of Detroit, Mich., has issued patent No. 1,029,063, for a motor vehicle in which guards at the sides of the body extend to the rear of the body and a license plate is mounted on and directly above the rear extended part of one of said guards while a lamp is mounted on and directly above the extended part of the guard with one of its lenses facing the license plate so that the rays of light from the lamp will illuminate the license plate.

Two Hudson Maxim Patents.—Mr. Hudson Maxim has secured two patents, Nos. 1,028,472 and 1,028,473, for vessels of war. The vessel presented in the first patent has two oppositely disposed longitudinally extending water compartments for its immersion with inlets and outlets leading to the front and rear respectively and a propeller in proximity to the rear outlet; while the second patent is for a torpedo boat consisting of two hulls united longitudinally end to end with a war head carried by the forward hull and an auxiliary explosive head carried at the front of the war head.

A Machine that Demonstrates Varnishes.—In a patent, No. 1,029,223, issued to the Ohio Varnish Company of Cleveland, Ohio, as assignor of Walter R. Rae of Chicago, there is presented a demonstrating machine in which is combined means for automatically performing repeated cycles. These cycles include the application of the material such as varnish, the manipulation of such material, such for instance as to produce an effect illustrative of graining and then the automatic obliteration of the graining so that the apparatus can repeatedly produce to the eye the effects of the application and manipulation of the material in order to permit its use in advertising a particular material.

Rope Horseshoes.—An industry which might, it seems, be developed to advantage in this country, is that of rope horseshoes. These are largely used in Germany and some other foreign countries and should find favor here because of the large mileage of paved streets in most American cities. The rope portion is inserted in a metallic body or frame and in most instances provision is made for withdrawing a worn rope section and replacing it with a new one. In some instances the rope which is sometimes tarred has wire or other reinforcing material interwoven with it. Berlin is the headquarters of a syndicate composed of eight manufacturers located at different points of Germany. Possibly the practical development of the industry in this country would necessitate the modification of the shoe either in its metallic or rope portions or both to adapt it to local conditions.

Activities in Inventions. — Activities along certain lines of inventions result from various causes. Sometimes the demand creating the activity is local, at other times it is universal, while it is, at other times, produced by some peculiar condition calling for special results. Thus the large number of apartment houses has led to the activity in the class of automatic fire recorders for indicating the precise location of a fire within the area covered by the apparatus. Automatic telephones have experienced an impetus from the installation of phones in small series which do not warrant the expense of a "hello girl" exchange. Local conditions in California and Colorado, those great resorts for consumptives, have contributed largely to the insistent demands for antiseptic mouth pieces for telephone transmitters, many patents for such devices eventuating from applications filed from such States. This offers a field for invention which is practically as unlimited as that for individual drinking cups.

Legal Notes

Recent Adjudicated Patents.—Out of five adjudicated cases reported in the Patent Office Official *Gazette* of June 4th, 1912, only one patent was declared invalid. This was the design patent to Boldt, No. 39,921, for a bottle, and the U. S. Circuit Court of Appeals held this patent void on its face for lack of patentable novelty and invention. In the other four cases, three were held not infringed and one, the Truffault Re-issue patent, No. 12,437, for a shock absorber for vehicles, was held valid and infringed.

A Process After an Apparatus Interference.—In deciding *ex parte* Gold, Assistant Commissioner Billings referring to the question of *res adjudicata* said, "it is perfectly apparent that if the claims state merely the adjusting of the device so as to operate it in the way in which it was designed to be operated they are not separably patentable from the machine itself—in other words, that they are but different statements of the invention defined by the apparatus claims. It, therefore, follows that the judgment in the prior interference is a bar to the allowance of any claims the alleged method of which could be carried out by the apparatus in issue in that interference."

Securing Benefit of Foreign Application.—In the case of *ex parte* Barthels, Assistant Commissioner Billings has held that "Where an applicant claims the benefit of the filing of an application in a foreign country for the purpose of overcoming a reference, his affidavit, filed under the provisions of Rule 75, 'should be accompanied by a copy of the original foreign application, certified to by the Patent Office of the country in which it was filed, and if it is not in the English language, a sworn translation of the same or a translation made by the official translator of this office. If the application was not made by the inventor himself, applicant's affidavit should also state that the application in the foreign country was filed for his benefit and that such procedure is in accordance with the procedure in the foreign country.'"

Concealment of Invention.—Asst. Com. Tennant in the case of Quenzer v. Callis again indicates the danger of concealing an invention in the event of a contest arising as to priority. In this case the Board of Examiners in Chief held that in view of C's concealment of the invention, he had forfeited his right to a patent, and the Assistant Commissioner in affirming the decision of the Board quotes portions of the decision of the Court in the case of Warner v. Smith, 84 O. G., 311, including the following: "Can one who has made an invention and who has locked it up in the secrets of his own exclusive knowledge and who produces it only when some rival inventor has entered the field be held to have acted in accordance with the policy of the law or with the spirit and purpose of the constitutional provision? Such action, or inaction, as we might more properly term it, not only contravenes the interests of the public, but also operates to injure the rival inventor who in the meantime enters the field of invention."

A Marconi Decision.—Mr. Chief Justice Shepard in the Court of Appeals of the District of Columbia has held that "When after the termination of an interference the losing party presented claims which were necessarily included in the scope of the decision in the interference and concluded thereby, it was the duty of the Commissioner to reject such claims."

The facts in this case are stated to be as follows:

"M filed two applications disclosing different species of the same invention; but in neither of them was the invention claimed broadly. After the declaration of the interference between the later application and an application of B, a patent was granted on the earlier application. The interference was decided in favor of B, and thereafter M sought to reissue the patent with claims broad enough to cover the devices disclosed in both of his applications. *Held*, that these claims were properly refused on the ground that M's right thereto was concluded by the decision in the interference."

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

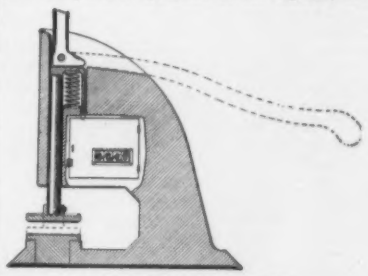
Of Interest to Farmers.

PLOW AND CHOPPER.—C. P. BERMES, Route 9, Carrollton, Ill. The aim in this patent is to provide a machine especially designed for plowing up corn stubs and chopping the same with the stalks into small pieces or fragments, and scattering the same over the ground to be subsequently plowed in for fertilizing purposes.

COVER FOR PEACH BASKETS.—I. W. PECK, Bradentown, Fla. This cover will prevent injury to the fruit from pressure, either external or internal, and by means of which the grower will be enabled to pack and ship his largest and finest fruit, and have the same arrive on the market uninjured by undue pressure from the cover or other crates stacked upon the crate in question.

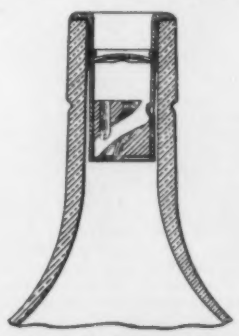
Of General Interest.

REGISTERING SEAL PRESS.—C. D. STAMPER, Williamsburg, Ky. This invention has in view a press having associated therewith a register to indicate the number of impressions taken, the press and register being so combined as to secure simplicity of construction and insure the positive operation of the register, access to the latter being had only by the removal of a closure, ordinarily in the nature of a hinged door, which door is normally locked and sealed, and is to be opened only by the proper officer. The engraving shows a longitudinal vertical section through a registering seal press constructed in accordance with the invention.



REGISTERING SEAL PRESS

NON-REFILLABLE BOTTLE.—W. E. GIROUD, 333 Decatur St., Brooklyn, N. Y., N. Y. Use is made in this invention of a valve mounted to travel in a spiral path in a valve casing, the valve having a spiral groove closed at its lower end when the valve is in lowermost position and is seated on the apertured bottom of the valve casing, the groove being open for the passage of the liquid at the time the bottle is tilted and the valve is off its seat. The engraving of this improvement shows a sectional side elevation of the non-refillable bottle with the valve in closed position.



NON-REFILLABLE BOTTLE

GATE.—H. C. ANDERSON, R. F. D., Mount Vernon, Wash. In the present patent the invention has for its object the provision of a single and cheaply constructed device, having means whereby it may be opened by persons on horseback or in vehicles without descending from the horse or the vehicle.

TORCH.—J. Z. HANSON and R. THORP, care of J. Z. HANSON, Aberdeen, Idaho. This invention relates to a torch particularly adapted for burning underwood or rush. The torch is balanced to permit of ease in carrying the same, and a further object of the inventors is to provide a torch which will form a low forwardly-spreading flame in advance of the same.

SPRING JOINT.—W. D. TUSTEN, 757 Macon St., Brooklyn, N. Y., N. Y. This improvement relates to a form of spring joint, that provides efficient means for housing the spring by which the joint is actuated, and the intention is to produce a superior joint which can be used in almost any relation where two parts are to be folded together.

UMBRELLA.—T. SUSEMIHL and C. P. CARRINGTON, care of T. SUSEMIHL, 1796 Fulton St., Brooklyn, N. Y., N. Y. The more particular purpose here is to provide the umbrella with means whereby it may be disassembled and compacted into a small space and carried if desired, in a small case for the purpose. When spread

open and in active use, it assumes two distinct forms suitable for use under different weather conditions.

HORSESHOE.—A. M. H. DE BRUYCKER, 173 Seventh Ave., Brooklyn, N. Y., N. Y. This inventor provides a horseshoe provided with detachable anti-slipping devices to permit the horse to obtain a sure foothold especially when going over icy roads, slippery pavements and the like. Use is made of anti-slipping calks ex-

HORSESHOE

tending transversely across the under side of the shoe and having upwardly-extending lugs engaging the outer and inner sides of the shoe, and transverse fastening pins extending through the said lugs and through the shoe to fasten the calks in place. The illustration pictures in perspective the shoe as applied to the hoof.

PASTEURIZING APPARATUS.—C. PAULSEN, Copenhagen, Denmark. The characteristic feature of this invention consists in the very large heating surface employed in proportion to the size of the apparatus, and in the means provided for the good and thorough stirring which can take place, and lastly the ease with which the apparatus can be taken apart and cleaned.

NON-REFILLABLE BOTTLE.—L. SCHAFFERT, 675 Knickerbocker Ave., Brooklyn, N. Y., N. Y. The inventor provides a bottle which cannot be refilled but will permit the ready efflux of liquid from the same. Another object is to provide a bottle in which it is difficult to obtain access to the means closing the same. And further to provide a bottle which cannot be opened by exhaust pressure.

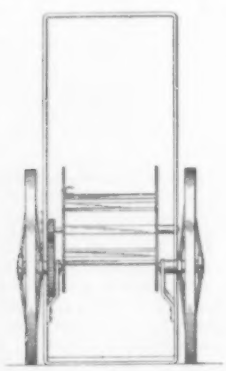
DEVICE FOR PREVENTING SPREAD OF EXPLOSIONS IN COAL MINES.—J. COSAVELLO, 1148 Penn Ave., Pittsburgh, Pa. In this patent the object of the inventor is to provide the chamber of a coal mine, in which coal is being dug, with a suitable device coöperating with the doors leading into the said chamber so that should an explosion occur in this chamber, the doors will be closed immediately.

Hardware and Tools.

HOSE LOCK.—O. V. JACKSON, care of R. B. MCCULLOUGH and R. L. PHILIPS, Brunswick, Ga. In this invention the improvement relates to hose locks designed to unite the end of a hose to a section of piping or nipple in such a way as to form a watertight joint and to permit the hose to be conveniently attached to the end of a water main or hydrant.

CURRY COMB.—W. E. STEYDING, P. O. Box 311, Mineola, L. I., N. Y. The present invention has for its purpose to provide a curry comb of simple form and arrangement having improved means for cleaning the operative surface of the comb, and also to insure a better grasp of the hand on the implement while in operation.

GARDEN HOSE REEL.—E. D. MERIKLE, 308 Ayerigg Ave., Passaic, N. J. Among the principal objects which the present invention has in view are: to form a reel adapted to automati-



GARDEN HOSE REEL

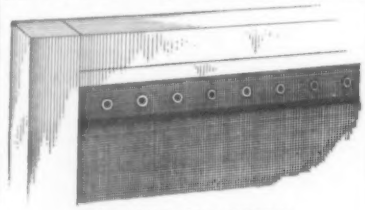
cally wind the hose as the reel is moved along the path of the same to avoid dragging the hose over the ground; to provide in a reel of the character set forth means for releasing the winding drum from the rotary mechanism therefor; and to provide means for holding the reel in upright position to serve as a sprinkling adjunct. The reel is shown in a front view in the illustration.

Heating and Lighting.

FURNACE FOR GAS GENERATORS.—F. J. ORR, 761 Prospect Ave., Buffalo, N. Y. This invention conserves the maximum units of heat by heating the walls and interior structure of the furnace to a radiating condition, which, after being raised to the necessary temperature, is there maintained by renewing the heat lost by radiation; and provides a conveyance of air and gas through the walls and structure of the furnace to produce the maximum effect.

Household Utilities.

FLY ESCAPE FOR SCREENS.—H. W. WELTY, 416 E. 40th St., Chicago, Ill. The intention in this case is to provide a screen for doors and windows of buildings so constructed as to permit the escape from the building of such flies and other insects as may be upon the inside and yet effectually prevent the entrance to the building of such flies and insects



FLY ESCAPE FOR SCREENS

as may be on the outside. The screen comprises a frame of the usual form and of any usual or preferred material. The accompanying illustration provides a perspective view of a portion of a door or window screen embodying the invention and looking at the outside thereof.

BRACKET.—W. PEPLOWSKI, 414 Bedford Ave., Brooklyn, N. Y. Among the principal objects which the invention has in view are: to provide brackets adapted for installation without marring the trim or finish of a door or window opening. It is to obviate a number of objections that the present brackets are provided with means for securing them to the trim different from that heretofore employed.

Machines and Mechanical Devices.

BELT SHIFTER.—E. J. EGAN, Winchester, Ky. This invention has for its object the provision of a simple and positively operated mechanism for use in shifting a belt on stepped cone pulleys, wherein the shifting mechanism is supported on a traveling carriage, operated by a traveling cam.

DITCHING MACHINE.—N. W. GRIBLER and A. G. GRIBLER, R. F. D., 4, Van Wert, Ohio. The purpose here is the provision of a device which will remove the soil by layers, until the ditch is completed, and which will be entirely automatic in its action, and wherein a grinding means is provided for constraining the machine to follow the ditch.

MACHINE FOR PILING TEXTILE FABRICS.—C. J. PRIESTER, 25 Bleecker St., New York, N. Y. Among other provisions this invention provides means for supporting and depositing devices, rods, or other retaining means for holding the fabric at each end of the lay performed by the machine; provides means wherein anchoring devices for holding the cloth at the ends of the lay are carried, and from which they are automatically fed; provides means for feeding cloth to a cutting table to prevent trapping the air between layers of cloth to disturb regularity of the lay; provides for guiding cloth from the piling machine to the lay; provides receptacles for the cloth-anchoring devices and adjustable means for feeding cloth therefrom when delivered in bolt or piled form.

FLEXIBLE COUPLING.—W. J. FRANCKE, care of John Waldron Co., New Brunswick, N. J. In the present patent the improvement has reference to shaft couplings, and the purpose is to provide a new flexible coupling arranged to insure proper transmission of the power from one shaft to another even should such coupled shafts be out of line or out of center.

MACHINE FOR CUTTING SLICES OF BUTTERED BREAD AND SANDWICHES.—S. A. GAGÉ, 13 Rue de Presbourg, Paris, France. This invention relates to a machine for the production either of slices of buttered bread or of sandwiches, the machine being so constructed that the two pieces of bread shall be of the same thickness and the slices of buttered bread or sandwiches, as the case may be, delivered in a continuous way.

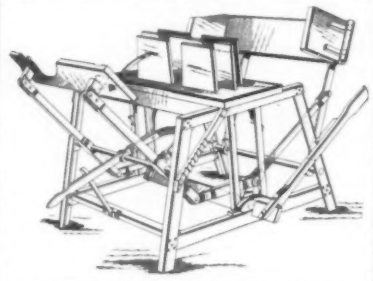
ROCK GATHERING AND EXCAVATING MACHINE.—D. A. GILCHRIST, Belgrade, Mont. Draft animals may be attached to this machine, and it is constructed so that it may be operated automatically when advanced by the horses to pick up rocks lying at or near the surface of the earth. A special arrangement is made for adjusting the device to this work, and scoop attachments are provided for use to transform the machine into an excavator.

CENTRIFUGAL PUMP OR BLOWER.—M. NEUMAYER, care of W. C. Green, 506 Bell Block, Cincinnati, Ohio. This machine is simple in construction and rendered very effective in operation by the use of a special runner and a plurality of suction chambers, so that the fluid passes through the machine in stages with increasing velocity, finally leaving under a desired pressure and predetermined delivery capacity.

SAFETY FIRING ATTACHMENT FOR BREECH LOADING RIFLES.—F. HARTNEY, Field Hospital No. 2, Présidio of San Francisco, Cal. This invention relates to rifles for sea coast defense and mounted on disappearing carriages. The aim is to provide an attachment for breech-loading rifles, arranged to prevent firing of the loaded gun until the latter is raised in firing position, thus preventing premature discharge of the gun into the projecting parapet.

CLOTH LAYING MACHINE.—A. H. VAN DEVANDER and J. E. MOORE, care of H. VAN DEVANDER, Cedartown, Ga. This machine will stack superposed layers of cloth in predetermined lengths in a smooth and even manner, with the least possible effort on the part of the operator. The machine can be used to lay different lengths of cloth and stack them by hand or power, in a pile on an adjustable cloth receiving member.

CEMENT BLOCK AND BRICK MACHINE.—W. I. KENNEDY, Goshen, Ore. The entire machine as shown in the accompanying illustration is constructed of iron and steel and is very strong and of comparatively light weight. It is also easily operated. The hinging of the ends prevents any tendency of the ends to pull on

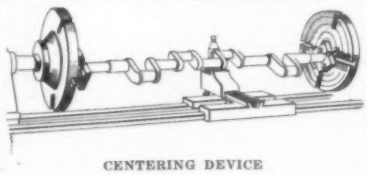


CEMENT BLOCK AND BRICK MACHINE

the ends of the formed block. The object of the invention is to provide a machine adapted for making blocks or bricks wherein a plurality of interchangeable pallets is provided, and a plurality of interchangeable core supports, the pallets having openings through which the cores pass when the support is in place, and a sectional mold resting on the pallet.

METHOD OF PERFORMING OPERATIONS INCIDENTAL TO MACHINE EMBROIDERY.—H. BOSSHARDT, SR., 955 Hill St., Hoboken, N. J. This invention relates particularly to a method of forming a combined color filled and embroidered fabric where figures are stenciled on the fabric instead of forming said figures by means of color covering or leaf stitch and more particularly to a method of pantographically forming a duplication of the figures on a pattern blank and in forming outlining stitches bounding said figures after they are stenciled on the fabric.

CENTERING DEVICE.—F. L. WHEELING and F. A. ROGERS, 746 Lake St., Los Angeles, Cal. This device is for use on lathes and similar machines, and more especially for centering "offset" work such as crank and cam shafts, valve eccentrics, etc., arranged for keeping the work in one center while one or more cranks or cans are being turned. For this purpose, use is made of a face plate attached to and



CENTERING DEVICE

rotating with the head stock spindle of the lathe, a tail stock face plate mounted to rotate on the tail stock spindle, and work-carrying means adjusted laterally on the said face plates, for supporting the ends of the work eccentrically to the axis of the spindles. The engraving shows a rear view of part of the lathe with the centering device, and showing a crank shaft for turning the cranks thereof.

WORD COUNTING ATTACHMENT FOR TYPEWRITERS AND TYPESETTING MACHINES.—E. F. GOIN, Nardin, Okla. This inventor has in view a compact registering appliance applicable to any typewriting or typesetting machine, and readily thrown into and out of operation, as well as reset, by depressible keys. Thus the working of the counting device can be carried on the same as if it formed a part of the key-operated mechanism of the machines.

Prime Movers and Their Accessories.

INTERNAL COMBUSTION ENGINE.—DR. R. H. POWELL, Grafton, W. Va. The objects here are to provide a device by means of which the scavenging of the engine may be effectively accomplished; a device in which a higher compression is secured; a means for cooling the piston and the cylinder; a device in which the carbon deposit on the piston and cylinder is reduced to a minimum, due to complete combustion; and a device capable of using a longer stroke.

Railways and Their Accessories.

BRAKE SHOE ADJUSTER.—J. S. ASHWORTH, Box 124, Cuyahoga Falls, Ohio. This invention has for its purpose to provide a simple apparatus which may be used on car trucks either with outside or inside brake shoes for automatically adjusting the position of the brake shoes relatively to the wheel, to take up the slack caused by wear.

RAILWAY SWITCH.—C. E. ESTES, Livingstonville, N. Y. This positively-acting device is operable from the street car, the switch being thrown by the motorman to either of its positions by depression of an operating member carried by the car, the member in each instance at either side of the switch working one of the two aligning operating cams as the car passes thereover, which cams are rapidly connected and ordinarily arranged between the rails, one of these cams being thrown up to operative position when the other is depressed to throw the switch.

Pertaining to Recreation.

BUBBLE BLOWER.—F. H. CORDTMEYER, 23 Greenpoint Ave., Woodside, L. I., N. Y. This inventor provides an apparatus the operation whereof results in the formation of a plurality of soap bubbles, one contained within the other; and provides means contained within the apparatus for insuring the formation of the bubbles in the prescribed manner and correlation.

Pertaining to Vehicles.

RESILIENT VEHICLE WHEEL.—H. J. SHEEDY, care of J. R. SCHLAGER, Stowers Packing Co., Scranton, Pa. This wheel has a hub and a rib member spaced therefrom and disposed thereround, there being recesses in the hub and in the rib member for receiving projections on pneumatic members, which are disposed between these members, the pneumatic being reinforced by rods having threaded terminals projecting through terminals of the pneumatic members, and which are engaged by nuts pressing the terminals of the pneumatic members against shoulders on the rods, the nuts engaging neighboring nuts.

SPRING TIRE FOR VEHICLES.—S. R. CREWS, Tampa, Fla. This invention has for its object the provision of a practical, efficient, and durable spring tire for autos and other motor vehicles in which metallic springs are substituted for pneumatic pressure. The invention applies a punctureless tire having the same elastic quality as the more expensive pneumatic tires now generally used.

PUMP FOR AUTOMOBILE ALARMS.—W. H. GARLOCK, P. O. Box 666, Seattle, Wash. This device is for use in compressing air to sound an alarm. It is capable of being operated by hand or foot of the driver, and may be applied to vehicles of any construction without change in the vehicle itself, and wherein the operative parts are thoroughly protected from weather and external violence.

Prime Movers and Their Accessories.

OSCILLATING VALVE.—J. W. DAVIS, care of C. G. HALL, Box 249, Whitefish, Mont. This invention relates particularly to oscillating valves for locomotives, and to means for permitting the engine to run free when the valve is shut off. It automatically connects the intake and exhaust ports of the cylinder when steam is shut off so that the piston may freely move without creating any back pressure.

ROTARY PUMP.—R. H. DANNER, 414 E. 64th St., Los Angeles, Cal. The object here is to provide a new and improved rotary pump, more especially designed for use in bored or driven wells, and arranged to prevent the bearings of the pump shaft from being cut by sand or other extraneous matter.

Designs.

DESIGN FOR A BADGE.—MARY F. SLATTERY, care of MR. COWAN, 1418 Fifth Ave., Manhattan, N. Y., N. Y. This ornamental design embodies the Irish emblem of the shamrock and the snake, the animal lying obliquely across the stem and partly on the two lower leaves.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12655) "A Reader for Ten Years" has asked us as to the most modern method of making gelatine sheets, and what machinery to use, etc. We must emphasize the fact that we do not answer anonymous communications. All letters must contain full name and address of writers.

(12656) T. S. S. asks: Has there ever been any way discovered to make rain by artificial action? A. There is no proof that any rain has been produced artificially, or when rain would not have fallen by natural causes. The U. S. Weather Bureau has many times said this. It is very unlikely that any shock can be given to the air by exploding powder to cause the condensation of moisture to rain, since thousands of cubic miles are involved in even a moderate storm. This topic is treated in Milham's "Meteorology," a new book, which we send for $4.50.

(12657) We very frequently receive the question, "Is the Mississippi River higher at its mouth than it is at its source?" A correspondent recently criticised our saying that the river is farther from the center of the earth at its mouth than it is at its source, and also that it ran down hill all the way from its source to its mouth; that is, the source is higher above a water level than is its mouth. Both of these statements are true, and we propose to discuss the matter more fully. There are two points involved in the question: the figure of the earth, and the relation of the river at points along its course to the level of the sea. First, the figure of the earth. Those who would read a *résumé* of this subject will find a clear statement given in the Encyclopedia Britannica, eleventh edition, vol. 8, pages 801-813. The figure of the earth is defined as "the surface of the sea imagined to percolate the continents by canals." It is therefore a water-covered surface along what is called the sea-level. Mathematically it is an ellipsoid of rotation, as shown by Laplace in his "Mecanique Celeste," and, in English, by Sir George Airy in "Mathematical Tracts," and many others, among whom we will name Sir George H. Darwin, the son of Charles Darwin, and not less illustrious in mathematics than his father in biology. The generating ellipse is rotated upon the polar axis of the earth, which is also the minor axis of the ellipse. To determine this ellipse numerous measurements of arcs of meridians have been made in various parts of the earth, from the equator to Hammefest beyond the Arctic Circle. The results are discussed by A. R. Clarke in the "Comparisons of the Standards of Length" in 1866, and in his "Geodesy" in 1880. The conclusions reached are that the equatorial semi-diameter of the earth is 20,926,202 feet, and the polar semi-diameter is 20,854,895 feet. These are the dimensions of the earth employed by astronomers and geodesists in their computations, and they may be relied upon as having but a slight probable error. It is thus seen that the equatorial semi-diameter is longer than the polar by 71,307 feet, or 13.504 miles very nearly. It is upon this that the statement usually made is based that the equator is 13 miles farther from the center of the earth than are the poles. And thus it is that a river running toward the equator in either hemisphere is rising farther and farther from the center of the earth as it flows over the surface of the earth. We referred this question to the U. S. Coast and Geodetic Survey and received from them the following data: "The distances from the center of the earth to points on the spheroid (that is, the average sea-level surface of the earth), using approximate latitudes, are as follows: Mouth of the Mississippi River, lat. 29 deg. 00 min., 6,373,159 meters. Source of the Mississippi River, lat. 47 deg. 10 min., 6,366,524 meters." Reducing the difference between these two numbers to miles, we find that the mouth of the Mississippi River is 4.12 miles farther from the center of the earth than is its source. Doubtless most of our readers understand that this figure of the earth has resulted from the centrifugal force of its rotation upon its axis, while yet plastic in its early history, producing the equatorial ring about 13.5 miles deep. Along this surface water will not flow. It is the water level of the ocean. If the source of the Mississippi River were 4.12 miles nearer the center of the earth than its mouth is, there would be no flow of water in its bed from the source to the Gulf. We may also point out that it is along this water-level surface that a ship sails on the ocean. If a ship could sail from the pole to the equator, it would at the end of the voyage be 13.5 miles farther from the center of the earth than when it started from the pole, and yet it would have sailed along a water-level surface all the way. A ship does not sail up hill in sailing toward the equator, nor does water flow 4.12 miles up hill in running from Lake Itasca to the Gulf of Mexico. It is raised to that height by the earth's rotational velocity. This brings us to the second point in the question, the altitudes of the river at various places along its course. "Higher" of course refers to altitudes above sea level. Here we have recourse to the excellent "Dictionary of Altitudes," compiled by the U. S. Geological Survey, fourth edition, 1906, and give the heights of extreme low and high water for several places, with the dates when these heights occurred:

Place.	Low, feet.	Year.	High, feet.	Year.
New Orleans, La.	1	1888	15	1882
Red River, La....	6	1872	52	1882
Vicksburg, Miss..	42	1872	94	1884
St. Louis, Mo....	379	1844	414	1883
St. Paul, Minn...	683	1878	702	1881

Lake Itasca, Minn., altitude 1,664 feet.

If we take the figures for extreme low water, it is evident that the Mississippi River falls 1 foot in the 106 miles from that city to the Passes at its mouth; and that it falls 6 feet in the 310 miles from the Red River to its mouth; and that its total fall from the source to the Gulf is 1,664 feet. As we said in our former answer to Query 12618 to which exception was taken, "The Mississippi River flows down hill all the way from the source to its mouth, which means that the source is higher above a water level (which is sea level) than the mouth is. Water does not anywhere on the earth run up hill [except under pressure in closed channels] nor along a water level. It can only run from a higher level to a lower level."

(12658) G. P. G. asks: Suppose that we have two electrical resistances, equal when hot, and in series, so that they will each absorb the same amount of energy. Let one resistance take the form of say a tungsten lamp, so that it will emit the largest possible amount of light. Let the other resistance be composed of such a length and thickness of say iron wire that it will be only black hot. Here we have two resistances each transforming the same amount of electrical energy, the first into light and heat and the second into heat only. Query: Will the number of thermal units liberated be the same in each case?—a thermal unit being that amount of heat necessary to raise 1 pound of water 1 deg. Cent. If you answer "Yes," it is evident that we get the light for nothing, which is not thinkable, and I would ask, is there any theoretical limit to the amount of light that may be produced from a given number of watts? A. We must answer your question that the heat generated is the same when the current and resistance in two circuits of the same metal are the same, for the same length of time. The formula is

$$\text{Calories} = 0.24\ C^2Rt \text{ in seconds.}$$

That a part of this radiated energy is of a short wave length which can affect the eye as light when it happens to enter an eye, but the rest is of such long waves that it only affects us as heat and does not affect the sum total of energy radiated at all. Heat and light are not two energies, but one appreciated by different senses. The same waves which affect the retina as light would, if they impinged upon the skin, affect the nerves by which the sensation of warmth is produced. The energy is not light till it affects the optic nerve, nor heat till it is perceived by the proper sense. It is not a case of getting anything for nothing. We get so much radiant energy. That portion which we use as light we do not use as heat, and *vice versa*. We know no theoretical limit to the watt value of a candle. The arc lamp produces a candle for the least electrical energy. What can be done to reduce this cost we cannot say.

(12659) C. V. H. asks: In your number of April 27th you stated that any object which does not float at the surface will not float at any depth. What is, then, the reason that divers use lead boots and other weights in order to sink and keep their balance in underwater wrecking operations? A. Divers use lead weights upon their feet to sink them, because otherwise they would float and not sink at all. The air within their rubber suits would prevent them from going down. The weights are heavy because they need to push and work at the bottom, and unless they have a heavy weight they would have no power to do any work, but would be moved about by the slightest pressure against any object. They could not even walk about. The weights on their feet are much greater than are required to sink them.

(12660) W. C. R. says: I observe that in the case of the "Titanic," as of other steamers that have foundered, it is stated that when the vessel sank the boiler exploded. I can understand that a mass of water rushing in upon the fire would create a vast amount of free steam; but should that have to do with pressure in the boilers, which one would expect to be lessened with the extinguishment of the fire? A. The sudden entry of water into the furnaces would generate large quantities of steam, which would rush up the uptakes and smokestacks. This and the roar of the escaping steam might lead to the belief that the boilers had exploded. The cold water would tend to condense the steam in the boilers and reduce the pressure.

(12661) W. H. J. asks: To what depths have divers gone? A. The "Encyclopedia Britannica," vol. 8, page 329, states that the greatest depth at which useful work has been done is 182 feet. A Spanish diver recovered silver from a wreck at this depth. Sponge fishers dive to a maximum depth of 150 feet, and the pearl fishers go to about 120 feet. The SCIENTIFIC AMERICAN, vol. 106, No. 22, gives the account of a submarine going to a depth of 200 feet.

NEW BOOKS, ETC.

THE NEW NAVY OF THE UNITED STATES By N. N. Stebbins. Introduction by the Admiral of the Navy, George Dewey, U. S. N. 150 half-tone illustrations. New York: Outing Publishing Company. Price, $1.50.

Printed descriptions can do much in describing a warship, but a photograph or a drawing can do much more. It was with this conviction that the author of the present excellent work, who is a marine photographer by profession, has gathered together a series of photographs taken during the past twenty years by himself of the ships of our new navy. The author, whose studio is in Boston, was particularly well situated for the task, for the reason that of late years most of the trials for speed of our warships have been carried on at Rockland, Maine, and Mr. Stebbins has made a point of being present and taking photographs of the ships on their full-speed trials, whenever it was possible. In the early pages are to be found some excellent views of the older ships of the navy, including the "Constitution" of 1797, the "New Hampshire" of 1817, and the "Hartford" of 1858. The new navy dates from the early eighties, and the photographs include some excellent views of the ships of the celebrated "White Squadron," such as the "Boston," "Atlanta," and "Chicago." The later ships follow pretty much in the order of their construction, and the last views include such late ships as the "Florida" and "Utah." Also there will be found reproductions of wash drawings of the battleships "New York" and "Texas" and "Wyoming" and "Arkansas" now under construction, and a deck plan of the "Nevada" and the "Oklahoma." The list of views includes the colliers, the converted yachts, and the cutters of the Revenue Service. Capt. H. Uberoth's article on the Revenue Cutter Service is one of the most attractive features of the work.

EFFICIENCY AS A BASIS FOR OPERATION AND WAGES. By Harrington Emerson. New York: The Engineering Magazine, 1912. 12mo.; 254 pp. Price, $2.

THE TWELVE PRINCIPLES OF EFFICIENCY. By Harrington Emerson. New York: The Engineering Magazine, 1912. 12mo.; 423 pp. Price, $2.

If American industry, judged by easily attainable standards, is only thirty per cent efficient, then the sooner American industry awakes to the situation, the better for all concerned. Are we wasting nearly seventy per cent of our time, energy, and money? Could a few changes in industrial administration abolish the bread line and the necessity for feeding seven hundred starving children at the East Side schools, and incidentally place the United States in a position where she need not rely upon her exceptional but failing resources for commercial pre-eminence? Eliminate this seventy per cent of waste, says Mr. Emerson, and men may work less laboriously, receive higher wages, and deliver a better and cheaper product. The works exhibit a masterly command of facts and illustrations. They are broad and humane without being vague, keen and precise without being narrow, and they compel the most serious consideration. When manufacturing plants, railway repair shops, and building operations are shown by reliable statistics to be carried on in so wasteful a way, certainly the remedy offered should be thoughtfully studied. It is not an untried experiment, but a plan that has already spelled success in many instances. Briefly, it is to furnish the old-line organization with standards, and to supplement it with staff organization. The line should no more resent this aid than—as Mr. Emerson has it in one of his happy illustrations—the commander of a submarine resents the squeaking of the mouse that warns him of the presence of dangerous gases. The author proceeds to show the application of staff and standards to a typical shop. Five surveys are run to determine the condition of machines and tools; the relation between what men are actually doing and what they should do; the relation between current costs and standard costs; the speed of movement of work through the shop; and the degree of efficiency in handling and checking materials. The old method of finding costs after completion of the work, is superseded by the new method of anticipating them; in fact, predetermination of results is the main characteristic of the new method on the cost accounting side. It is claimed that "the efficiency system" has resulted in reducing locomotive repair cost from eight cents, ten cents, and even twelve cents per mile to six cents, and that in other activities the reduction in expense has been as sweeping and extraordinary. In "The Twelve Principles of Efficiency" the system is further amplified and expounded, and its claims substantiated by citations of actual accomplishments. In short, we must characterize these as two remarkable books whose every word is worthy of careful study and whose tenets demand the most careful test.

SOAP BUBBLES. Their Colors and the Forces Which Mold Them. By C. V. Boys, F.R.S. New York: E. S. Gorham, 1912. 16mo., 190 pp.; illustrated. Price, 85 cents.

"Soap Bubbles" is a series of most fascinating experiments bearing upon the elastic skin of liquids, capillary attraction, the tension and curvature of soap-films, and the color, thickness, and possibilities of soap bubbles. The substance of the book was originally delivered in the shape of popular lectures before juvenile audiences, and serves admirably to awaken the youthful mind to the marvels of natural phenomena, and to incite it to further and more serious study.

CONSTRUCTING CONCRETE PORCHES. By A. A. Houghton. New York: The Norman W. Henley Publishing Company, 1912. 59 pp.

CONCRETE BRIDGES, CULVERTS, AND SEWERS. By A. A. Houghton, 132 Nassau Street, New York: The Norman W. Henley Publishing Company, 1912. 55 pp.

These two books may be commended for their clear, concise discussion of important phases of concrete construction.

TEXT-BOOK OF PHYSICS. By C. E. Lineberger. Boston: D. C. Heath & Co., 1911. 12mo.; 471 pp.; illustrated.

As an elementary text, written for the average student, appeal is first made to any knowledge of the topic which the average student may be expected to possess; definitions are as crystallized as it is possible to make them; what little apparatus is used is carefully set forth in explanation and illustration; principles are concretely applied; and problems of moderate difficulty, calling for constructive reasoning, are furnished in abundance. The arrangement of material is sound, and its variety and attractiveness commendable.

METEOROLOGY. A Textbook on the Weather, the Causes of its Changes, and Weather Forecasting, for the Student and General Reader. By Willis Isbister Milham, Ph.D., Field Professor of Astronomy in Williams College. New York: The Macmillan Company, 1912. 8vo.; xvi, 549 pp.; illustrated. Price, $4.50.

Meteorology has had a long struggle for recognition as a suitable subject for the university curriculum in this country. Why this is so it would be difficult to say, in view of the fact that weather is a subject of universal interest. However, the anomaly of the situation appears to have been brought to the attention of academic authorities, and within a few years past courses in meteorology have been introduced at a score or more of our institutions of higher education. A suitable textbook for these courses was an urgent desideratum, which Prof. Milham has happily supplied in the treatise under review. Since the publication of Prof. Loomis' now antiquated, but still highly useful, "Treatise on Meteorology," no work on this subject has appeared in the English language at all approaching Prof. Milham's book in its availability for use in the college classroom. Let us hope that some one will soon supply the equally pressing want of a textbook for high schools to replace the obsolescent elementary treatises of Davis and Waldo.

As a textbook, Milham's book may be compared with the second, condensed edition of Hann's "Lehrbuch der Meteorologie," than which it is more comprehensive, but less thorough. Thus, Milham covers several important topics that Hann completely ignores, e. g., meteorological instruments, weather prediction, and atmospheric optics. On the other hand, for rigorously scientific explanations of atmospheric phenomena in the light of modern investigations, Milham's treatise can by no means be accepted as a substitute for the great German authority; and the teacher who uses Milham's textbook in his classes will need to have at hand both editions of Hann for constant reference. On the descriptive side, Milham is adequate, but on the theoretical side rather superficial, and sometimes inexact.

For the general reader, Milham's book may be recommended as a compact body of up-to-date information. It is especially to be commended for its cosmopolitan outlook. As a rule, an American work on meteorology is apt to be too American, and an English work too English; but Milham has drawn his information from all available sources, and especially from the rich storehouse of German science.

As to make-up, each chapter begins with a useful syllabus of its contents, and closes with collections of questions on the text; topics for investigation; practical exercises; and references; all of which is in accord with the best pedagogic practice. The appendix contains a copious classified bibliography. Charts, pictures, and diagrams are numerous and generally excellent, though the charts would have been more instructive if coloring had been more generously used. This is a point in which American textbooks suffer in comparison with German.

This book has one serious blemish, which we feel it our ungrateful duty to point out—in the spelling of foreign words and names, with which the book naturally abounds, flagrant errors occur by the score. We must hold the author responsible for the bungling of personal names with which the publishers' staff could hardly be expected to be familiar; as "Dové" for "Dove"; "Mühy" for "Mühry"; "Fisher" for "Fischer"; "Lemstron" for "Lemström"; "Edward Buckner" for "Eduard Brückner"; etc.; but author and publisher are jointly to blame for the numerous egregious blunders in the spelling of everyday French and German words entering into the titles of the works listed in the bibliographies; such as "Erganzungscheft" for "Ergänzungsheft"; "atmospherische" for "atmosphärische"; "practique" for "pratique"; etc. The number of such errors in the otherwise excellent bibliographies is truly appalling.

V.—Shall My Boy Become a Chemical Engineer?

By M. C. Whitaker, Professor of Engineering Chemistry, School of Chemistry, Columbia University

[This is the fifth of a series of articles intended to set forth fairly the business possibilities of the technical professions. The articles are prepared by men who are connected with the more important technological institutions of this country and who are for the most part prominent educators. Because these teachers have instructed hundreds of young men in the principles of engineering, they are best qualified to write upon a subject so immensely important in the future development of American manufacturing industries.—EDITOR.]

THE industrial progress of a nation depends primarily upon the skill and inventive talents of a certain portion of its population. The natural resources of a country may be exploited by a foreign people, but the national benefits from a true industrial growth can come only from native initiative. Industrial wealth increases as a result of research and discovery, and all developments not based on solid scientific knowledge are unstable and soon become undermined.

The first requisite for permanent industrial growth, therefore, is a class of leaders of thorough scientific training combined with a natural or acquired talent for developing applications. Advancement in the science and the art of mining, railroading, electrical applications and mechanical developments is necessarily solely dependent upon such a body of men. The more thorough and complete the training, the greater will be the facility with which they handle the inevitable new problems arising in their work, and the greater will be their contribution to the profession of engineering, and to permanent industrial development.

Schools of mechanical engineering have for forty years met the demands for men to develop the innumerable applications of mechanical principles and physical laws, and the graduates of these schools are engaged all over the country in designing, building and operating appliances for the utilization of power and the transformation and application of energy. The effect of their work may be seen in the development of the multiple expansion steam engine, gas engine, steam turbine, transportation machinery and innumerable other mechanical applications.

The education of men for the applications of electrical energy has kept pace with the development of the dynamo, the motor, the telephone and the telegraph, wireless telegraphy, etc. Our railroads, buildings, bridges and municipal works are directed and developed by the products of numerous schools of civil engineering. No one would question the wisdom of the establishment of schools to provide the training for these engineers. The scientific and industrial development in their respective fields has amply justified the existence of such schools and the demands for their graduates are constantly increasing.

There still exists, however, a branch of engineering, the scope and possibilities of which are greater than all of the others combined, and that is the field of manufacture involving the principles of chemistry. The value of the chemical products manufactured in the United States during the last year aggregated over $8,000,000,000. The development of the men to build up, manage and operate the numerous units going to make up this great industrial division has, until recently, been largely a hit and miss matter.

Who is best equipped to design, build and operate our factories and processes founded on chemical principles? Certainly not the electrical engineer, educated to work around the pivotal point of electrical theory and with little or no knowledge of chemistry. Certainly not the mechanical engineer, specially trained in the development, use and application of power and energy; nor the civil engineer, educated in the theory and practice of construction; nor the mining engineer, educated to win the raw materials from the earth. Among the classes enumerated, we find only those who are specialized in the recovery of raw materials and those trained to make applications of the finished products. The intermediate step—that of manufacture—has been entirely omitted. Our failure to recognize the need and to provide men trained in the application of engineering methods to chemical problems is amply illustrated by reference to the history of a number of our noted developments. The chemistry of the Solvay soda process was available for thirty-five years before the engineering difficulties were solved. Our present water gas system lay dormant for fifteen years before engineering talent could make it commercially successful. The principles on which the wonderful contact process for sulphuric acid is now operating, were well known to the chemist for many years before the indispensable chemist-engineers were found to solve the large scale applications. The electrochemical principles published by Faraday lay fifty years awaiting the development of the mechanical and electrical appliances needed to perform the chemical functions. The European monopoly of the world's supply of sulphur was broken by a man who had the courage and skill to engineer well-known physical and chemical principles and thus create a new American industry.

In the other engineering branches there is usually a prompt application of newly discovered principles, but in the chemical field there is often a long delay between the publication of a new idea and its successful industrial application. Innumerable illustrations might be cited to show the lack of correlation between the science of chemistry and modern engineering development. If the principles followed in the training of mining, civil, mechanical and electrical engineers are correct, and their results seem to justify this conclusion, the field of chemical manufacture has been sadly neglected, and the difficulties experienced in the upbuilding of many of our now successful processes have been due to a scarcity of men trained in the special field of chemical engineering.

Other engineering developments are already being hampered by unsolved chemical problems. Some of these problems remain unsolved from lack of knowledge, some from lack of resources to pursue the necessary investigations on an illuminating scale, and others from the failure to centralize engineering resources around the focal chemical point. Railroad engineers are demanding improvements in the chemical composition and manufacture of steel to reduce the number of catastrophes occasioned by the rapid increase in the speed and weight of trains. Disintegration of structural materials like cement and steel are hampering engineering development, and chemical manufacture itself is handicapped by a lack of refractory metals and materials. Fuel problems, food problems, illumination problems, problems involving the conservation of life and property, are becoming more pressing as a result of the advance of general engineering. In almost every one of these difficult and important problems, the solution will come through a better knowledge of chemistry and its applications.

Some of our leading institutions are fully alive to the importance of chemical engineering as a profession and are providing excellent courses of training both in the fundamental sciences and also in the study of the applications. These chemical engineering courses require new and expensive laboratory equipment quite different in kind from that heretofore used in engineering school instruction, and infinitely more varied in its scope. The development of great laboratories of engineering chemistry will naturally offer the best facilities for the investigation of great industrial problems. In such schools, men with a knowledge of the theoretical sciences may be taught the best application known to the combined engineering profession.

INQUIRY COLUMN

Inquiry No. 9264.—Wanted, the name and address of manufacturers of Date Fitting Machines.

Inquiry No. 9265.—Wanted, names and addresses of manufacturers of machinery for making picket fences.

Inquiry No. 9266.—Wanted, to buy machinery for fastening wire cloth to wooden frames with coppered tacks.

Inquiry No. 9267.—Wanted addresses of manufacturers of metal specialties in connection with plate or window glass.

Inquiry No. 9273.—Wanted, to buy a globe for a parlor fountain, working on the Heron system.

Inquiry No. 9274.—Wanted, the name of a manufacturer of a machine to make cushion covers for fruit crates.

Inquiry No. 9275.—Wanted, name and address of manufacturer of stock patterns of platen job printing presses.

Inquiry No. 9276. Wanted a household convenience and necessity which can be retailed at a profit at a price of from $1.00 to $2.00.

Inquiry No. 9277. Wanted. A machine for packing dry batteries.

Inquiry No. 9278. Wanted. A machine for separating crab meat from the shell.

Inquiry No. 9279. Wanted. A machine for shredding asbestos board.

The Annual Convention of the Master Car Builders' Association

By Reginald Gordon

THE annual convention of the Master Car Builders' Association was held at Atlantic City, N. J., June 12th to 14th, inclusive. The deliberations of this body of practical railroad men are always productive of matter of great value to the transportation world, especially in this day of large, heavy, steel cars, increasing rate of wages and always closer supervision by State and national commissions. There is a marked tendency among the various technical, railway and manufacturers' associations, of which there are many now in existence, to work together in the investigation and solution of the new and increasingly complex problems that arise from time to time in the economical operation and maintenance of railways. A large proportion of the membership of these societies is composed of technically educated men, whose opinions and decisions on questions relating to their respective departments of a railroad are of great value, involving, as they do, the expenditure of millions of dollars annually for labor, new materials and supplies.

After the address by the president of the M. C. B. Association, reviewing the work done during the past year, and the general progress made in car construction, the convention listened to a report upon specifications for cast and rolled steel wheels for cars. The experience gained during the past few years with the wheels used on 50-ton capacity coal and ore cars has shown the necessity of establishing rigid specifications governing the chemical composition, method of manufacture and mode of testing of steel wheels intended for that kind of service. While the majority of wheels in use under freight cars are of chilled cast iron, a kind of wheel that has given years of satisfactory service in the United States and Canada, many railroad men now distrust its margin of safety under modern conditions with heavy loads, which in the case of a loaded car means a weight of 37,000 pounds carried on every one of the four axles. The effect of bad track, the brittleness of the material at the low temperatures that are common above the 40-degree parallel of latitude, and the excessive heating caused by the brake shoes applied to the wheels on long descending grades, require a wheel that is very strong, hard and tough in its characteristics. The steel wheel costs more than that of chilled cast iron at first, but its dependable period of service is longer. Nevertheless, there were many members at the meeting who advocated the continued use of cast iron wheels, having found them satisfactory for all kinds of freight service; particularly on account of the low first cost and the guarantee by the manufacturers of a definite life or mileage, in addition to an allowance for scrap value when worn to the limit of safety. The wheel makers also are willing to furnish a cast iron wheel guaranteed for use under cars of 70 tons capacity; but as yet there are only a few of the latter, for special service such as the transportation of bridge members, large castings or heavy guns.

A very timely discussion was held on the inspection of box cars, with particular reference to the transportation of their contents without loss or damage. At all important divisional points, freight cars are inspected in the running gear, couplers and air brakes, in order to determine whether the cars are fit to run. An examination of the roofs and doors for leaks; of the floors to determine whether there is any oil, lime, acid or any other wet or corrosive substance that would damage certain classes of goods; or of the sides and ends for the removal of projecting nails, splintered boards, etc., is seldom thoroughly done. Then again, many cars are sent out loaded but so insecurely fastened that the theft of their contents is an easy matter and one that is constantly occurring. The members agreed that much more detailed inspection of cars is needed, as is evidenced by the enormous sums of money constantly paid out by railroad companies in settlement of claims for loss and damage of goods

in transit. They also urged upon all their fellow members the serious consideration of stouter construction, better materials and more frequent inspection of all parts of box cars in order to reduce the loss from the causes mentioned.

Owing to the increasing variety of the distillates of petroleum that must be accepted for shipment in bulk, the M. C. B. Association has found it necessary to promulgate specifications for the construction of tank cars for the transportation of different kinds of oils, naphthas, benzine, etc., to cover not only the material to be used in the tank plates, but also the method of construction, whether riveting or welding; and the size and location of the safety valves on the same. These specifications are also in accordance with the requirements of the Inter-State Commerce Commission on the same subject. Safety valves on tank cars must be set so as to blow off at a specified pressure, in proportion to the vapor tension of the liquids contained; and must operate and relieve the pressure when the vapor pressure increases by reason of the heat developed by any fire to which the car may be exposed, either by reason of wreck or a conflagration near the track.

A committee reported to the convention that the railroads have great difficulty in securing satisfactory rubber hose for air brake and signal connections. They find that some hose stretches too much, becomes soft, porous and leaky; and, on the other hand, some hose becomes brittle, and cracks, also causing air leakage. It is a matter of common knowledge among engineers and trainmen that locomotive air pumps in freight service are overworked; and this is largely because in a long train there are usually many leaky hose lengths to which air must be supplied in order to maintain normal pressure in the train pipe. The committee has drawn up specifications covering the quality of rubber and canvas to be used in the manufacture of standard air-brake hose.

Another question to which the convention gave considerable attention and discussion was the report on the electric lighting of trains. As is well known, there are three principal systems in use: (a) the "head end" system, employing an engine-driven generator in the baggage car; steam for the engine being supplied from the locomotive; (b) storage batteries carried in boxes under each car; and (c) the axle lighting system, having a generator mounted on one of the trucks of each car and driven by a belt passing over a pulley on the axle. This system also employs a storage battery as an auxiliary, to supply electricity when the train is not running as well as at speeds less than seventeen miles per hour. Two standard voltages, 30 and 60 volts, are in use; the tungsten lamp is now in common use for this kind of lighting, in fact, is used almost exclusively, and a great deal of study and experimentation has been turned upon finding the best kind and shape of shade to furnish pleasant illumination, bright enough for reading, without objectionable glare. Car wiring is put in regular conduit, and all circuits are brought to a switch panel in the car and provided with approved types of fuses. Few people realize the advance that has been made in the art of train lighting during the past two years; and in this connection the Association of Railway Electrical Engineers has done a great deal of work in developing the details of successful electric lighting for trains; not only in designing new apparatus, but in perfecting mechanical appliances for axle mountings, battery boxes, etc.

Other topics presented and discussed were those on car coupler side clearance and standard dimensions, best location of train pipe for steam heat connection, freight car springs and cast steel truck frames. The committee on brake shoe tests also reported progress in the investigation of rate of retardation of revolving car wheels by brake shoes at different pressures. It was stated, however, that the results on the brake shoe testing machine are not strictly comparable with service conditions, where the wheel is rolling along a rail, and that consequently the conclusions must be accepted with caution.

The subject of car shop apprentices was brought up, and the consensus of opinion seemed to be that boys who enter a shop as apprentices do not have sufficient encouragement held out to them to induce them to continue in the car department of a railway after they have become first-class workmen. In consideration of the knowledge and skill acquired during apprenticeship, many young men seek employment where they can obtain better pay; usually with the railway equipment manufacturers; so that the railway companies have a rather limited number of trained, skilled men upon whom to depend for making promotions.

The sessions of the M. C. B. Association closed on June 14th, and were followed a few days later, June 18th, by those of the Master Mechanics' Convention, held also at Atlantic City.

Experiments with Blue Glass

(Concluded from page 11.)

Through two or more thicknesses of blue glass look at a lighted candle placed at a distance of more than six feet from your eye. While so doing hold your forefinger vertically in contact with one corner of your eye and bring it slowly toward the center of the eye until it intercepts a part and only a part of the beam of light which passes through your pupil (see the accompanying figure), that is, until the light of the candle suddenly becomes dimmer. Instead of one flame you will then perceive two. They stand side by side: one is blue, but the other is as red as blood, without any admixture of blue. Thanks to the anachromatism of the human eye, the crystalline lens acts in that case as a prism and the suppression, through the cobalt glass, of almost every intermediate color between the two extremes of the spectrum allows the clear separation of the red from the blue. As to the forefinger its object is to close the central part of the pupil and to allow the passing of light only through the most anachromatic part of the crystalline lens, i. e., its margin.

Chancing one day to look through two glasses, one blue and one yellow, placed one behind the other, the physicist Simler was amazed to find out that while other objects were but little changed, foliage and grass had become of an intensely red color. A glance at the spectrum of the light reflected by chlorophyl explains the mystery. This spectrum contains an extraordinary amount of the extreme red for which the cobalt glass is transparent. Most other colors are stopped either by the blue or by the yellow glass. The experiment is well worth being made, as the appearance of a landscape with everything about as usual except that every leaf or bit of grass is as red as blood is extremely fantastic. Unless the blue glass is very thick and dark two pieces, one behind the other, must be used. One yellow glass is enough. It is essential that the vegetation be in full sunlight. Diffused light on a cloudy day gives no results at all.

Although the writer has come across more than one mention of the curious experiment he is about to describe, he has been unable to find the name of its author. Besides the blue glass a concentrated solution of quinine sulphate, to which a few drops of sulphuric acid have been added, is needed. With this liquid used as ink and a pen cut out of any piece of wood (a steel pen should not be used), the experimenter writes on a sheet of white paper. When dry, the script cannot be read, as quinine sulphate is as white as the paper. But if it is placed in a dark room, in such a position as to be lighted only, or almost only, by a beam of sunlight which has passed through a blue cobalt glass, the handwriting, while so lighted, is plainly visible in white on a blue field. No other sympathetic ink equals quinine sulphate in the rapidity with which the script can be made to appear or to disappear.

The writer has failed to obtain similar results with a blue screen made of a concentrated solution of copper sulphate, which absorbs the red and most of the

Superheated Steam in Locomotive Service

AN Abstract of Publication No. 127 of the Carnegie Institution of Washington, by W. F. M. Goss, has just been issued as Bulletin No. 57 of the Engineering Experiment Station of the University of Illinois.

This bulletin gives a summary of foreign practice in the use of superheated steam; it contains a report of an elaborate series of tests made upon an American locomotive to determine the precise advantage to be derived from superheating under various conditions of locomotive service; and it shows that the use of superheated steam is not attended by serious difficulties. The superheater is easily maintained, and its presence as a detail of locomotive mechanism introduces no new problems in maintenance. The superheater improves the efficiency of the locomotive through the saving of coal and water. Tests run with boiler pressures varying from 120 to 240 pounds per square inch, for which the steam was superheated approximately 150 deg. Fahr., prove that neither the steam nor the coal consumption is materially affected by considerable changes in boiler pressure. This fact justifies the use of comparatively low pressures in connection with superheating. The saving in water consumption was found to vary from 18 per cent at a boiler pressure of 120 pounds to 9 per cent at a boiler pressure of 240 pounds, the corresponding saving in coal varying from 17 per cent to 6 per cent between pressures of 120 pounds and 240 pounds. The power capacity of the superheating locomotive was found to be greater than that of a saturated steam locomotive of the same general dimensions.

Copies of Bulletin No. 57 may be obtained upon application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

The Current Supplement

THE current issue, No. 1905, of our SUPPLEMENT brings a number of interesting and important articles. Mr. Cooley reports on some tests of vacuum cleaners.—Mr. Miller gives a concrete example of the applications of Motion Study to the improvement of manufacturing efficiency.—Mr. John Jay Ide, who is well known to our readers, describes the Tatin-Paulhan Aero Torpedo.—Prof. E. F. Northrup gives a most interesting survey of the range of temperatures known to us in the laboratory and in nature, and of the properties of matter as it is exposed to different portions of this large range.—There is no nation in the world's history which has shown such rapid rise from comparative obscurity to modern civilization as the Japanese. Something of what the Japanese have done in science is told us in an article entitled "Some Japanese Scientists."—The utilization of water-power through the medium of electricity, for industrial purposes, is a subject that can never lose its interest. An article on this subject, illustrated by a front page and other engravings, forms part of the present issue.—Mr. Hartley M. Phelps tells us of American industrial enterprise in India.—Mr. Tweedy writes on the Cold Storage of Furs and Fabrics.—Prof. Houssay, of Paris, discusses the body shape of fishes as influenced by the effect of water pressure.—Those of our readers who own microscopes will be much interested in an article on the fine adjustment of these instruments.—The subject of baldness and grayness, treated of in a special article, is one which is apt, sooner or later, to engage the attention of all of us.